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SCIENCE FICTION AND FACT

SEPTEMBER 2000

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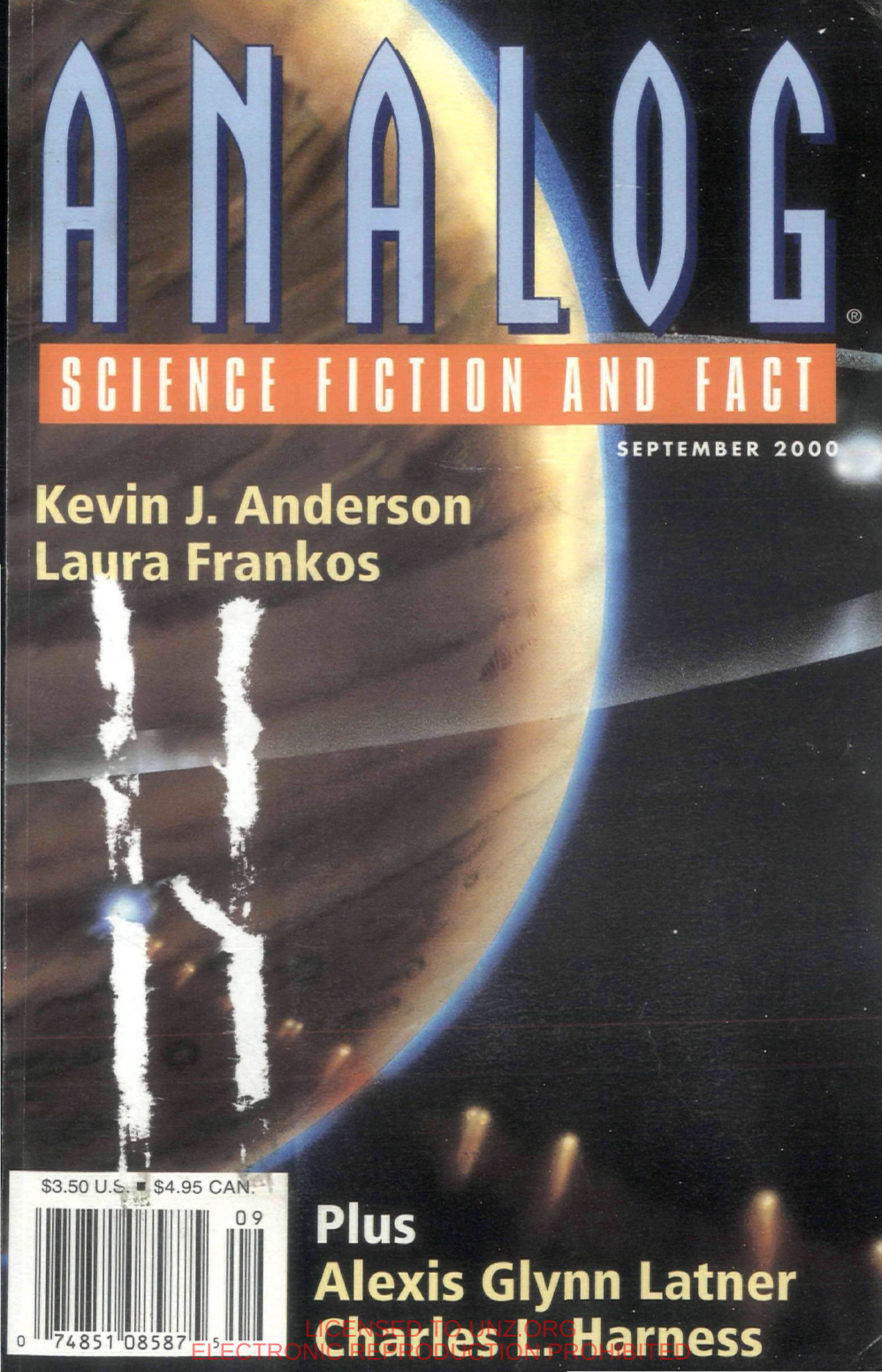

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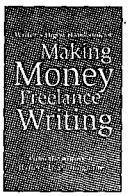

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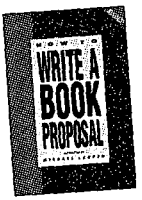

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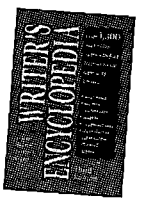

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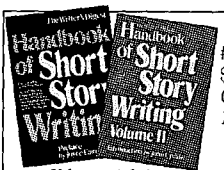

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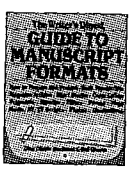

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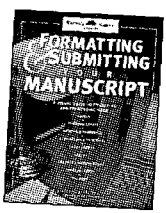

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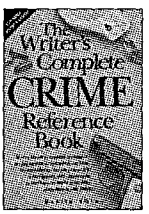

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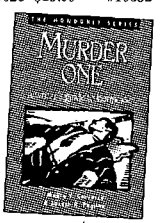

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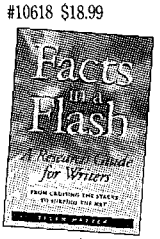

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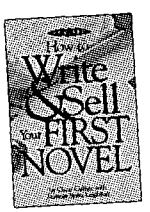

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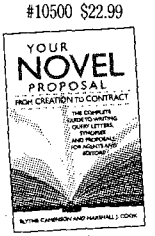

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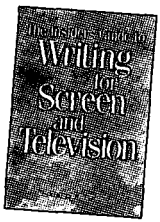

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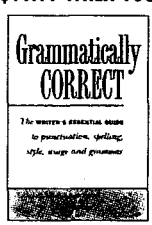

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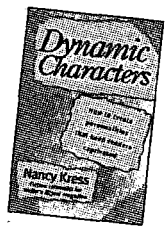

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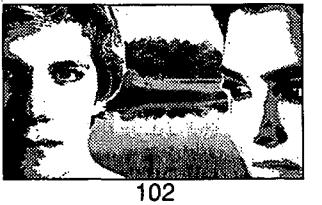

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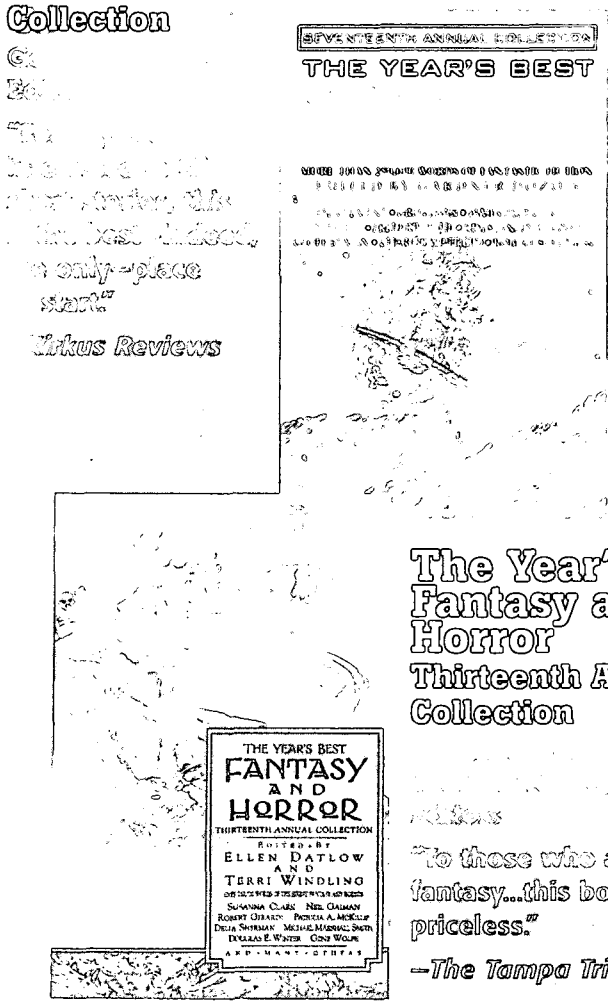

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EDITORIAL Stanley Schmidt

LEAP OF FAITH

A recent television series on animal intelligence unwittingly gave me a new insight into this ongoing business of people's attitudes toward that controversial concept. I've commented on this a number of times before,* so I won't repeat everything I could say on the subject. But it seems it just won't go away, and once in a while it provokes a new thought worth mentioning.

The essence of it is this. More and more research, by people like Jane Goodall, Dian Fossey, and Sue Savage-Rumbaugh, strongly suggests that animals of other species—e.g., apes, monkeys, parrots, and dolphins—show abilities and behaviors long regarded as the exclusive property of *Homo sapiens*, like problem-solving, tool use, language use, self-awareness, and emotions. And skeptics who don't want to accept that conclusion, including some scientists, keep coming up with new reasons not to accept the conclusions of that research. They say, for example, that even quite complex behaviors, which in humans would be considered obvious examples of intelligence, in other animals are "mere mimicry" or "picking up on subconscious cues unwittingly given by the experimenter."

Far be it from me to claim that anyone should accept these or any other results uncritically. Scientists *should* look for possible deficiencies in both data and analysis, both in their own work and in that of their colleagues. And certainly there are people who would so much *like* to believe that other animals share human-like qualities that that desire could color their interpretation of experiments.

But there are also people who so strongly want to believe in humanity's absolute uniqueness that that can color *their* interpretation of data. It has long seemed to me that that desire often shines through so strongly that what looks at first glance like the highest standard of scientific rigor may actually reflect a powerful, dogmatic faith. Some of the critics of research on animal intelligence are absolutely insistent on traditional laboratory-type "scientific" proof, despite the intrinsic peculiarities that make it at least difficult to apply those methods and standards to this subject matter. They are *so* insistent that it's hard to believe *anything* would convince them that any other animals have anything like human thoughts or feelings.

My epiphany, which brought into dramatically sharp focus just how much faith can be required for this kind of "scientific skepticism," came with a single statement from one of the people interviewed in the television documentary. No, I don't remember who said it, and it doesn't matter anyway. I'm interested in criticizing ideas, not people, and this particular view, or some variant of it, seems to be held by a good many people. But I didn't recall ever hearing it put

*E.g., in "Self-fulfilling Prophecies" (December 1980), "The Need to Believe" (June 1985), and "King of the Hill (No Matter What)" (July 1998).

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quite so baldly before, and when I did hear it, I found it quite astonishing.

The essence of it was this. The gentleman in question said it seemed to him that, despite all the claims he'd heard, there really wasn't much difference in intellectual abilities among the other mammals. They were all Down There, on about the same primitive level, while we were Up Here, on an exalted plane with minds functioning on a level quantitatively and qualitatively so far above *them* that it really made no sense to attempt comparisons.

I was instantly struck by how similar that sounded to Mark Twain's concept of Man as the Creator's Pet, except that Twain was being openly satirical and our contemporary scientist was evidently quite serious. And it occurred to me that, completely aside from the sizable body of data that the gentleman would rather ignore, his belief requires a simply enormous leap of faith—and faith in a far larger evolutionary leap than any of the animal intelligence researchers are asking him to accept.

Consider how evolution, in general, works. Complicated structures and organisms evolve from simpler ones by a series of small steps, each involving a single mutation in something that already existed. It does not jump suddenly from something very simple, like a light-sensitive cell, to something very complicated, like the eye of an octopus or an optometrist. The transition from the former to the latter is far more likely to occur by one light-sensitive cell becoming several, and then some of the many developing into different kinds of specialized cells. Eventually—but not at all suddenly—the process can lead to a structure including such sophisticated features as an adjustable-focus lens and a retina with different kinds of light detectors for different purposes.

That's obviously an oversimplified description, but the important points are that it happens by one relatively small step at a time, and each step involves modifying (at the genetic level) some-

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thing that already exists—not suddenly creating from scratch something complicated and utterly new. If you look back at the evolutionary precursors of any sophisticated contemporary organism, you will (at least in principle) find organisms showing earlier versions of any of its highly evolved features—sometimes as fossils, sometimes as living creatures that have branched off the evolutionary tree closer to the "trunk." It would be quite astounding to find a single animal with a very complicated eye or nervous system, without finding other animals (living or dead) with somewhat simpler ones.

So why shouldn't the same principle apply to minds and behaviors? I'll cheerfully and gratefully grant that we humans have been richly blessed in this area. Our mental equipment and abilities are indeed impressive compared to those of many other organisms. But are they really a huge quantum leap beyond *all* others? I find it extraordinarily difficult to take such a claim seriously. It sounds to me ironically close to Creationism: the notion that man is the Creator's Pet, a special, high-budget project that sprang full-blown from the brow of Zeus (or Whomever). Most people would agree that of all the equipment we humans have, our minds are the most remarkable. So is it really believable that in this most complex area, unlike anything else in evolution, everything else stayed about the same and we suddenly made this enormous jump to vastly greater complexity?

When I hear someone maintain that, I must wonder whether his mind is already so made up that there's little hope of facts ever changing it. If our minds and behaviors are as complex and highly developed as they seem, I find it far easier to believe that they got way by the same kind of long, stepwise progression as everything else about us. It then seems eminently reasonable to look around for the quantitatively different but qualitatively similar traits that were steps on the way to us. I think animal behavior researchers have found plenty of them, and I don't quite see the point of trying so hard to insist that they're anything else.

Whoever said "Extraordinary claims demand extraordinary proof" was right. But which is the more extraordinary claim? That we got where we are in one phenomenally spectacular leap, without leaving a visible evolutionary trail? Or that we did it in the usual way: by a long series of small, hard-won steps, each of which left a footprint—which dedicated researchers might find and understand?■

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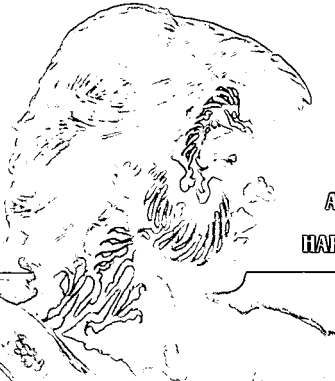

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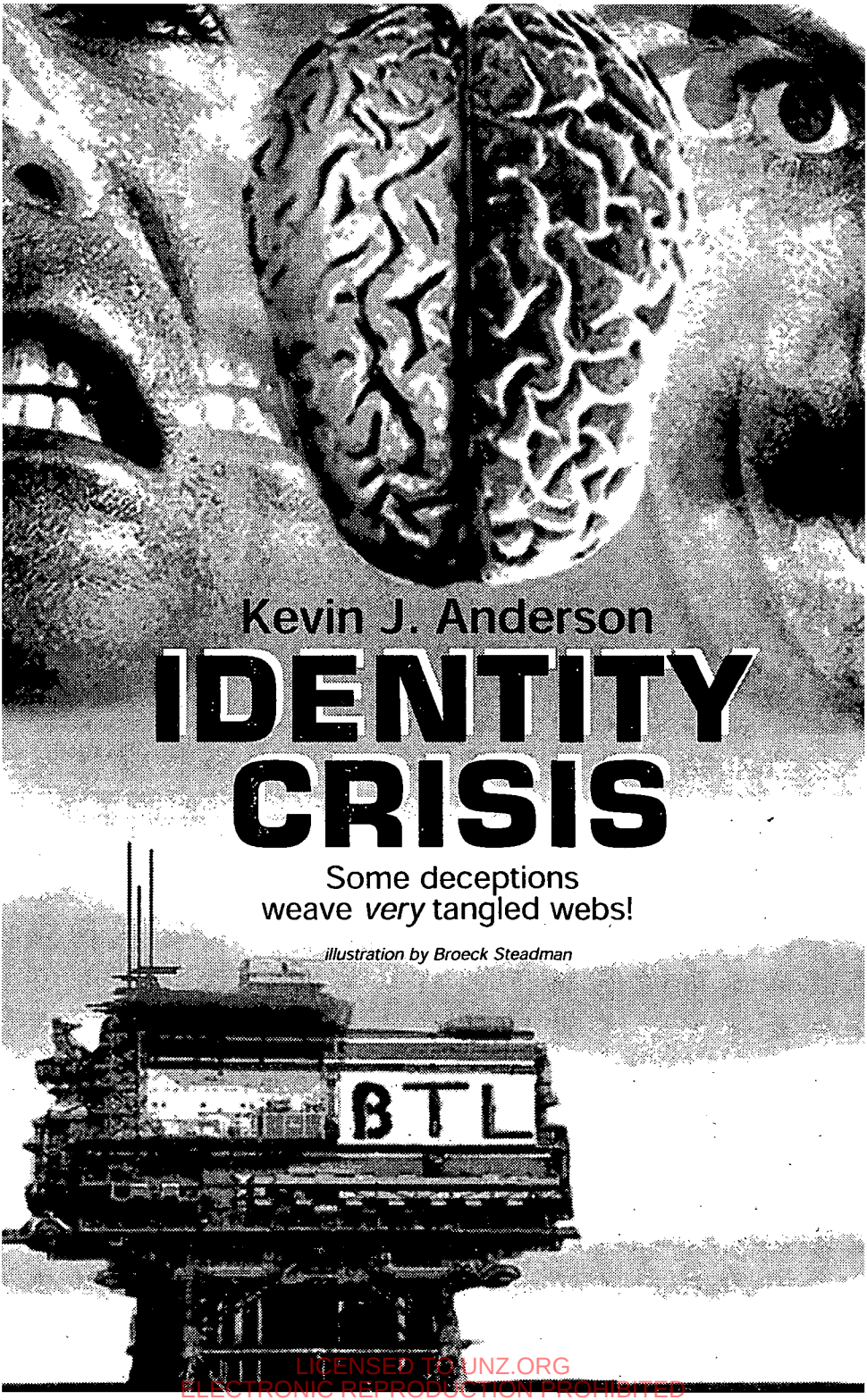

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I

Eduard lay on his narrow bed, cocooned in damp sheets, his pores seeping a cold, feverish sweat. He was all alone, shuddering, as the sickness coursed through the body. He hadn't expected the symptoms to be this bad when he'd volunteered his services.

In a single week he'd already spent four days in someone else's body, a limited-term hopscotch, enduring a miserable round of the flu just so some businessman wouldn't miss his meetings. Unglamorous, maybe, but it was a way to make a living.

The newsnet stories had called this a particularly virulent strain of influenza. It had much of the population worried, but Eduard knew he would get through it. He would survive. After all, he had asked for this. He had no one to blame but himself.

Trembling, he squeezed his puffy green eyes shut, seeing little explosions of Technicolor behind his lids. He sat up on the mattress, clutching his stomach, squeezing the middle-aged, flabby potbelly as his intestines knotted up. He swung off the bed and lumbered toward the bathroom.

He could have hurried faster in his own young and healthy physique, but this aging form had trouble just moving about, doing normal daily activities. Encumbered by the flu as well, Eduard had even greater trouble. If the man who actually owned this body had kept himself healthier in general, he might not have been so susceptible to getting sick in the first place.

But the man was a busy executive, with more credits in his account than he could spend. And such an important person couldn't afford to be laid up for an illness. He had board meetings to attend, fundraisers to throw, decisions to make, and publicity to spark. After only one day of feeling the flu grow worse and worse, the exec had become desperate.

And so he'd hired Eduard, who offered to be sick for him.

For an exorbitant fee, Eduard agreed to live in the exec's body for the time it took to recover. A hell of a way to earn spending money beyond his dull daily job, but also a great way to take advantage of the system. It was only pain and physical discomfort, after all—and it wasn't even his body. He could endure it. No problem.

With the amount of money he'd get paid for this ordeal, Eduard wouldn't have to work a real job for weeks, perhaps even months if he was frugal. And he'd certainly learned how to be frugal in the orphanage.

In the ailing body, Eduard staggered into the bathroom and managed to splash cold water on his face. The cheeks and skin felt oily with sweat, too soft from the extra fat padding his jowls. He looked in the mirror and saw a stranger staring back at him through his own eyes.

The exec's wife probably wouldn't mind him coming home to her in a virile young body. . . .

His stomach clenched again, and he vomited explosively into the sink. After a few moments, holding himself and shaking to get over the wave of nausea, he splashed more water, rinsed the facilities, then lumbered back to the bed, breathing shallowly. His lungs seemed smaller despite the largeness of this body.

Eduard kept telling himself he could put up with this. Only a few more days, then he could be back to normal once more. He considered contacting his friend Daragon—they'd grown up together in the orphanage—but Daragon's weird ability had made him a prime candidate for the Bureau of Tracing and Locations. Right now, he'd be too busy learning odd law-enforcement techniques to come see a miserably sick man.

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It was just a minor nuisance, regardless of how bad he felt. No problem. Eduard was a survivor. He did what needed to be done.

He slumped onto the sheets and wondered if he would be able to nap. He doubted sleep would come. He would toss and turn feverishly for hours as this weak body struggled to fight off the virus.

Eduard vomited twice more that night, then eventually fell into a deep, deep sleep. By morning the fever had broken. He still wasn't healthy enough to demand his own body back, along with his payment, but it would be soon. Another day or two. He had signed the appropriate waivers and he would tolerate the sickness until the exec's body returned to its nominal level of health.

He showered twice that day, trying to overcome the unwashed feeling inside this body, but he shook off the mood. He couldn't afford to think like that.

The following morning he did swap back with the body's original owner. After synching ID patches, Eduard drew a deep breath, flexing his arms and looking out the office window. It needed cleaning.

The exec was glad to have the flu over with, though he did seem a bit reluctant to give Eduard his young body back. Nevertheless, their contract had been consummated, and both parties were satisfied. Each time he finished such a deal, Eduard felt as if he had put something over on the world.

Daragon often frowned at what he did, but Eduard got paid well for it. He just had to go through a few brief unpleasant parts of other peoples' lives for them. It was a lucrative niche.

II

The hovercar left the main traffic patterns behind, cruising high above malls and pedestrian streets. Daragon, the Bureau's new trainee, peered out the back window as the vehicle wove through a complex of warehouses and cranes and launch platforms on sprawling docks that extended like pseudopods out into the Pacific. He watched the scrambled Brownian motion of commerce, bustling workers, small and large craft skating like water striders across the ocean, bullet-boats tugging barges into port.

What would Eduard think of this!

Far out on the water, cleanly separated from any structure on land but towering high enough to be an artificial island, stood a massive offshore drilling rig. It had been abandoned in place, modified into a new sort of building.

BTL Headquarters.

At the edge of the offshore city, the hovercar landed on a metal-plated dock that extended to the edge of the calm water. The emerald doors raised up like an insect shrugging its carapace. Daragon emerged, standing straight in his dark trainee jumpsuit. The fresh wind struck his face, laden with salt and iodine.

The man who met him on the platform was well muscled, his stomach like a washboard, the tendons in his neck like cords. With his presence, he seemed to occupy a much larger physical space than his actual body required. His hair was short and dark, just beginning to speckle with gray. His eyes were wide-set, a chestnut brown. "My name is Mordecai Ob. Perhaps you've heard of me?"

"Certainly, sir!" Ob was the Bureau Chief, a powerful man who kept himself isolated, ambitious but rarely seen except by those in the inner sanctum of the Bureau of Tracing and Locations. Why would a person of such importance waste time greeting him, or pay any attention to a new trainee whatsoever?

"Walk with me to my offices. I'll show you more of how the Bureau really works." He squeezed Daragon's hand with an exceedingly muscular grip. "We expect great things of you, young man."

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Ob led him down through connecting passageways that rippled with watery light, thick windows that looked out on an underwater world of fish and waving kelp. Lights dazzled from the outside, spotlights, attracting undersea creatures.

"We're linked to the mainland through computer and energy conduits," Ob said, "but BTL Headquarters is-by and large self-sufficient. Much of our work can be done long-distance, invisibly. We try to be unobtrusive when possible." Ob flexed his broad arms, as if relishing the feel of his own muscles.

Daragon dutifully nodded, knowing that expert searchers could find just about anything in the data-universe of the pervasive computer/organic matrix. "I've been taught many of the services the Bureau provides. But the wealth of available data on COM is so vast, finding anything in particular is like finding a needle in a world full of haystacks."

Ob smiled. "Our people are most adept at searching for needles. Inspectors, Guards, Tacticians, Apprehension Specialists, Saboteurs, Data Hunters, rank after specialized rank."

Some operatives were skilled in evidence analysis; they could detect infrared footprints or pick up DNA tracings; they compiled physical clues to help build a trail for Inspectors to follow. Still others were medical technicians trained to unravel brain scans, the mental fingerprints of the specific person who had lived inside a particular body. Ob took Daragon through warm and humid biological reconstruction labs, frigid computer galleries, humming offices, dazzling map rooms, image libraries bursting with an incomprehensible amount of information.

Finally, his mind numb with everything he was seeing, Daragon turned to the brawny man. "Can I inquire which section I'll be working in, sir? They all look . . . very interesting."

Ob's chestnut eyes shone. "Daragon, you are a true wild card. If you can *see* people's personas just by looking at them, no matter which body they're inhabiting, without consulting an ID patch, you perform a function none of these others can do, despite all our technology."

Daragon's heart fluttered. He had always felt apart from the others, even Eduard. He'd been unable to hopscotch into different bodies, like everyone else. He didn't know who his parents were, or why he had turned out this way. He felt worthless, a freak.

But his mental abilities had turned inward. He couldn't reach out and exchange minds with another person—but he could look at their souls and recognize them for who they were. He could *see* the true person, their aura, no matter what body they inhabited. Now that he thought about it, Daragon realized just how important it would be for an Inspector to glance over a crowd and spot the mind he was looking for.

Ob beamed like a proud father. "In all the years I've been in the Bureau, you're only the second one I've found. There are only a few known examples in any generation. Having you with us gives the Bureau an extremely valuable tool."

Daragon flushed. "And I always thought I was some kind of . . . throwback because I couldn't do what everyone else could."

Ob's generous laugh warmed the young man's heart. "Nonsense. Your telepathic breakthrough simply took a different form. BTL experts have been very interested in uncovering precedents in mental development. Way back at the dawn of time, the human race went through a 'bicameral revolution,' when our minds split into left and right hemispheres. *This* is a similar evolutionary step, with consciousness becoming detachable from our physical brains."

Fascinated, Daragon nodded vigorously. "I had always heard that the first hopscotching was triggered by generations of people uploading and downloading to old-style computer networks and virtual reality environments. That's how

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personalities first became detached from the body, and now most people can hopscotch with just a touch. But one thing has always puzzled me. The amount of data that needs to be transferred is so enormous, and to be done so quickly—"

Ob brushed off his comment, faintly condescending. "Yes, but at the root level, it all boils down to a form of telepathy. No one's ever clocked a benchmark telepathic transfer rate." He smiled up as a small shark swam past the thick window, its torpedo body sinuous. "I know you must have a million questions, but there will be time. You will become familiar with all the theories and all the analytical methods as your training continues. Once you join us, you are a part of the Bureau for life."

They stood together deep underwater, surrounded by girders and walls, curved windows that looked out into the sea. Ob patted him on the shoulder. "The world will be under your watchful eye, young man."

III

Eduard's first regular job after leaving the orphanage a year ago had been a tedious and boring routine, despite its superficial thrills. It was hot and dirty work, high up on the outside of the mirrored skyscrapers. Wearing a mag-lock harness that attached him to support struts between windows, he hung seemingly miles above the pavement. Below, the street crowds and hovervehicles swirled about, so far away they looked like colored pixels on a grid of the city.

Eduard spent his days with a cleaning and repair kit, zipping up and down the building exteriors, one structure after another, cleaning windows, patching cracks, strengthening bricks and blocks that showed signs of wear after decades of weathering.

Eduard dangled up where he could feel the breezes, sense the tantalizing drop below him. It made him *alive*, spending his days on the edge of peril. Such a contrast with his childhood with Daragon, which had been safe and protected and calm. Riding high above even the topmost airlanes of hovercars, Eduard had felt happy and fulfilled . . . but then his restlessness had kicked in again.

His work partner was a lanky and unambitious man named Olaf Pitervald. Olaf had big-knuckled hands and scarecrowish arms and legs. His pale skin flushed easily, and his pale hair was a colorless mass that covered his pink scalp.

Eduard could singlehandedly cover the entire side of a skyscraper faster than he and Olaf could do it together, but the lanky man liked to hang beside him in his harness. Olaf spent more time in incessant conversation than actually doing his job. "We get paid the same, no matter how hard we work," he said with a jerky shrug.

As Eduard diligently patched chinks using his polysteel compound, Olaf would gaze through the windows, searching out attractive female bodies. He would make cat-calls, treating any women he saw as sex objects, emboldened because he knew they could never hear his words through the glass. He was unmarried, probably because he'd never found the nerve.

"How do you like that one, eh?" Olaf pushed his face close to the glass, where a buxom cinnamon-haired woman sat in a lobby area directing visitors.

Eduard had no idea whether it was even a woman or a man inside the body; some corporations simply rented sexy females to act as living artwork in the reception areas. Then the corporations hired pleasant and competent employees to swap into those beautiful bodies during the workday.

Suspended in his harness, Olaf loved to stare, barely keeping the drool from coming out of his mouth. Eduard scowled. "So save up your credits, rent yourself the body of a stud, and go date one of those women." Olaf balked,

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though. He was stingy with his money, but also preferred his imaginary conquests to risking failure. Rolling his eyes, Eduard went back to work.

One day Olaf seemed more unsettled than usual, doing very little work. He hung in his harness next to Eduard, though he didn't seem to want to talk, offering only occasional bitter or surly comments. Finally, Eduard grew disgusted. "Either tell me what's wrong or leave me alone. You're even less pleasant company than usual."

"Facial surgery," the lanky man finally admitted. "Dental prosthetics. I have to get three teeth replaced." Grasping the harness with the crook of his right arm, Olaf jabbed his fingers along his jawline. "In here. They're going to laser-cut some molars and install organic prosthetics. Too much enamel damage, they say. Easier to replace than to fix."

"So?" Eduard said.

"I don't like the idea of somebody cutting up my mouth," Olaf pouted, "taking pieces out of me." He fretted in the harness.

Eduard frowned. Minor surgery didn't seem a terribly pleasant prospect, but nothing to be terrified about. No problem. "Are you worried about the operation itself? Or is it that you just don't want to be there when it's happening?"

"I want it to be all over with, and not have to sit through it and feel the pain." He moaned pathetically.

"Yeah, right." Eduard looked over at his partner as they both swung high, high above the streets. His eyebrows knitted. "How many spare credits do you have?"

"What do you mean?" Olaf looked suspicious. "Do you need a loan, eh? I don't lend money."

"Not to loan it. To *pay* it. You pay me, and I'll swap with you. I'll go sit through your dental surgery for you. You won't feel a thing."

Olaf stuttered, swinging in the harness. "No, I don't think so. I couldn't ask that of you. . . . Uh, how much would I need to pay?"

"A thousand credits."

"What!" Olaf couldn't believe what he was hearing. "I can't afford that!"

"Yes, you can."

"But I have to pay for the surgery, too. And miss a day of work."

"If you swap into my body, you don't need to miss a day of work. But if you'd rather sit there all alone while they go into your mouth with their lasers, chopping up your teeth, ripping them out . . . Have you ever smelled burning blood, Olaf? Smoke drifting out of your mouth and into your nose?"

"I can spare five hundred. That should be enough. It's only going to be a few hours."

"For five hundred, *you* can put up with it for a few hours," he said. "Give me nine hundred and you won't have to feel a thing until it's all over."

Sweat broke out on Olaf's brow, despite the sharp and cool breezes. He could see in Olaf's watery eyes that the other man desperately wanted to agree, and Eduard refused to haggle further. Nine hundred credits. Finally Olaf acquiesced.

At the end of the workday, Eduard swapped with him, spent the next afternoon in a polished office with all the high-tech surgery needs: anesthetics, quiet music, soothing scents that masked medicinal smells, and a competent dental surgeon with robotic assistants and absolute precision. It wasn't so bad at all.

When it was over, after he'd been paid and after they had hopscotched back into their home-bodies, Eduard didn't have the heart to tell Olaf that he hadn't felt a thing. The nerve deadeners had worked perfectly, the surgery had gone as planned, and Olaf still had to endure the miserable throbbing pains as his body healed. . . .

Afterward, Eduard had seen the whole prospect as an interesting opportunity. It was time for him to leave, to change, to do something else with his

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life. He began reading the want ads, requests for bodies or various partners. From that point, Eduard simply listed himself on the board, and word got around.

IV

Daragon had not set foot on the mainland in six months, and he saw no opportunity in the near future either. The Bureau and its concerns had become his life twenty-four hours a day.

His afternoons were immersed in the nuances of law enforcement, studying old cases, trying to solve forgotten mysteries.

Once humans had learned how to hopscotch, many legal precedents had to be set. The law stated unequivocally that the "perpetrator" of a crime was the *person*, the mind rather than the body. Prosecutions involved locating the mind that had been inside a human vehicle when any felony was committed, backtracking an identity through COM, or ID patches, or sheer detective work.

The BTL used technological means to unmask a mental imprint left on the host brain. A person's mind left readily identifiable pathways for a short while, much as a body could be marked by its own unique fingerprints. Unfortunately, such methods were time-consuming and involved excruciating pain for the suspect body, which more often than not turned out to be innocent.

Thus, Bureau Chief Ob had high hopes for Daragon, who could *see* the identities of people, mark guilty parties at a glance, no matter what bodies they wore. Daragon had the potential to become the greatest inspector of this age—if he worked hard enough at it.

And Daragon worked very hard.

Unlike the rest of the undersea headquarters, Ob's office was plush and warm. An ornamental gas fireplace brought a cheery natural light. The Bureau Chief said, "We've survived for over a century on the sharpest razor edge our civilization has ever encountered. Think of the opportunities for total upheaval, the lack of individualism as we have always known it. Without a ready and reliable means for instant identification of a 'person,' society would crumble into chaos. The sheer potential for abuse is awesome."

"Yes, sir. That is why the BTL is so important."

Ob tapped his fingertips together, bemused. "We can't even begin to keep track of everybody, Daragon, unless they themselves cooperate."

"Every person has an implanted ID patch, sir."

"Useless, unless the people synch after swapping. That is why the penalties are so severe. We must not let others discover that they *can* get away with fooling us."

"Yes, that would be dangerous." Daragon listened, not even thinking of being judgmental.

Ob raised the COM screen on his desk and punched in a request. He printed out the results, handing the hardcopy across the desk. Daragon's heart pounded as he took the paper and scanned the words.

"Your first legitimate case, tracking down a lost family member. Consider: a woman needs a vital medical treatment, something that can only be cured through parallel DNA-matching therapy. And that can only be done if she's able to find the home-body of her sibling. Unfortunately, he hopscotched out of his original body long ago, sold it in a long-term lease, which was transferred to another person, who died outside of the swapped body, which then went onto the open market."

Daragon read the particulars. He made a special effort not to smile or frown or show any sort of emotion whatsoever. That would be bad form.

"Thus, the family has to track down their son's lost home-body. A matter of life and death, and they came to the BTL. The son himself has kept in touch, but he's hopscotched from body to

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body as he took job after job."

Daragon pressed his lips together, then folded the printout and stuffed it into one of his pockets. "I'll find him for you."

"Yes, you will," Mordecai Ob said. "I have faith in you, Daragon. But don't find the body for *me*—do it for them."

In windowless chambers filled with bubbling coolants and life-support systems, the Bureau's mutated Data Hunters hung in limbo, living a surreal life with virtual bodies, lost inside the computer/organic matrix. Data Hunters were more efficient than any "pure" human, but also so far from normal life that sometimes the actual questions eluded their understanding.

Daragon stood inside the dim, dank-smelling room. As his eyes adjusted, he looked up to where the hairless, stunted bodies hung suspended in their harnesses, wired to the vast cosmos of COM. Their flaccid arms had withered through lack of use. Their spines were twisted, their heads over-large, their eyes squeezed shut and blind, seeing only through neural inputs that linked them into the sea of information.

"I need some help," Daragon said in a loud, firm voice. Bubbles continued to jet into the coolant and recirculation tubes. He saw no motion, no reaction.

One of the embryos drifted in its restraints and turned a sightless face toward him. A voice came out of a small speaker in the wall. "Ah, somebody's come to give me a purpose in life! What is it you seek? Wait, forgive my lack of social graces . . . we get no practice whatsoever in here." The body stirred faintly, as if a breeze had bumped its way through the room. Now, the voice came from a different place, disorienting Daragon.

"My name is Jax, and you must introduce yourself properly before you make your request. I'm not just a genie in a bottle who's required to give you three wishes, you know."

He was taken aback. He had anticipated Data Hunters to be alien and incomprehensible, not talkative. "My name is Daragon. Can I call your attention to a case file? If we locate an original body, we may be able to help a person who needs medical treatment."

"Ah, Daragon—a humanitarian gesture. How wonderful!" The hovering Data Hunter scanned the file in less than a millisecond. "Shouldn't be too difficult. It'll keep me occupied for awhile. That's what we're here for, you know."

Daragon nodded, not knowing what to say. He had never made polite conversation with a mutated husk before.

"But first, you must promise to meet my payment request," Jax said.

Daragon brushed down the front of his trainee Inspector uniform. "But you work for the Bureau. We're part of the same team. This is your job."

"Do you want me to help you or not?" Jax's body did not stir, but the voice coming from the speaker had an interesting lilt to it.

"What is your price?"

"I want you to come and talk to me," Jax said. "We don't get much company, and I can do everything else through COM. But the network can't provide plain, faulty human companionship."

"If that's all you want, then I agree to your terms."

"Good," Jax said. "Come back in an hour and I'll have the information you need. After that, I want you to come and tell me what you did."

V

Wearing his best suit of clothes, Eduard took the lift-tube to the plush upper levels of offices that were inhabited by lawyers of all kinds. He made a cursory check of his appearance, brushed down the front of his clothes, straightened his dark hair, and walked into the meeting with a stern, tough expression on his face. When the negotiations started, he had to make sure he got off on the right foot.

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A crowd of expensive suits waited for him in the boardroom—representatives of the client, family members, and legal counsel. No face bore the slightest glimmer of warmth.

Seeing this, Eduard wondered if *he* should have bothered to contract his own legal advocate. But the bargain was fundamentally simple, after all, and he understood all the issues. He'd done many such agreements before, but never with such formality.

Behind the boardroom table hovered several go-fers, lower-echelon employees anxious for any job in a big firm. Their sole purpose was to be on call during long and excruciating deliberations. Any time one of the executives had a full bladder, a go-fer would swap bodies and walk out of the room to relieve him- or herself. No need to put an important meeting on hold for such irrelevant interruptions.

At the end of the long table a cadaverous old woman sat propped. She leaned forward, bracing herself on shriveled arms. Her skin hung like loose fabric on her bones, tinted a grayish-green from the bizarre medical treatments she had already endured. Her eyes were sharp and reptilian, her nose pinched. Eduard had never before met a person who seemed so altogether unpleasant.

"I am very pleased to meet you, Madame Ruxton," Eduard said, pumping forced charm into his voice. Her lips compressed like a purse-string drawn tight.

The tallest lawyer stepped up, and others withdrew various documents from folders, spreading them out on the table. "You are aware of the risks, Eduard—uh, there's no last name listed."

"Don't have one." He waved the comment aside. "I was raised in an orphanage."

Flustered, the lawyer continued. "Madame Ruxton's surgery is serious, and you are being asked to endure it for her. Your survival is not guaranteed. We estimate a 20 percent probability that you won't live through the operation."

"I'll survive, no problem," Eduard said. "I'm strong, and I'll help the body through it."

"Nevertheless, we must face reality," another lawyer said. "You have been offered a very large sum of money in order to do this job. Madame Ruxton has guaranteed that such payment will be made—unless, of course, you don't survive the surgery."

"She'll still make the payment," Eduard said sharply. Without being asked, he took a seat exactly opposite from the withered old woman. "If I'm going to die in this woman's body, she can pay the fee one way or another. And the amount is triple if I don't survive the operation." Eduard's eyes suddenly hardened. "That decreases the incentive for any sort of medical mishap." Eduard drew out papers naming Daragon as his beneficiary.

The lawyers looked over at the old woman. She nodded sharply. They hadn't really expected to get away with a death disclaimer anyway. "But I get to keep the body, by default," the old woman said. "If you die."

Eduard took a deep breath. He had expected that part too, but he knew this was a battle he couldn't win. "If I'm dead I won't have any more use for it, will I?"

"Quite correct," Ruxton said.

The go-fers fidgeted, waiting for something to do. One of them offered more coffee to all the parties with a hopeful expression on her face.

Eduard picked up one copy of the thick contract, leaned back in the chair, and began to skim the paragraphs. He was aware of the various ramifications, and he flagged certain minor points that he insisted on changing, just for the sake of appearances. It all seemed standard, though he had never done this with such a risky and painful set of consequences.

"Are you certain you don't want legal representation of your own?" one of the

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other lawyers said.

Eduard raised his eyes, still holding the documents in front of him. "No. I can be as suspicious as anyone else."

He made the attorneys wait as he read through the entire document.

The old woman coughed, deep retching sounds, as if she had a gravel pit operating inside her lungs. Her family members flocked close by, attending her with exaggerated concern. Perhaps they even wanted Madame Ruxton to die, but now through Eduard she would have a new lease on life.

Eduard handed the contracts over while the rest of the attorneys bustled about making copies, certifying documents, and no doubt charging Madame Ruxton an exorbitant fee for their ministrations.

"When is your surgery scheduled?" Eduard asked, looking directly at the rich old woman.

The lawyers glanced at him, and Madame Ruxton tried to sit up straight, holding her posture with great effort. Her salamander eyes glittered at him. "Tomorrow," she said. "My body won't last long without it."

Eduard kept his face bland, surprised that they had cut it so close. "My calendar's open."

With a flourish of a pen that laid down magnetic ink, he signed the contract. He did not relish the prospect of living in the crone's body for the operation or the brief recovery period. But he could do it. He could survive this, and it would give him an importance and prestige he had never before had. He hoped it would be the start of many good things to come.

Eduard had long ago abandoned his high-rise window maintenance job. The actual credits didn't mean much to him. This was success for its own sake. It was *winning*.

After swapping into the aching and withered form, Eduard lay back on the surgery table. It was all he could do to lever himself on his elbows and endure the weight of sheets around him.

Ruxton's body was a collapsing ancient structure held together with cobwebs. The deep agony in his bones spoke of unspeakable musty age, and his heartbeat stuttered like the slow drumbeat of a dirge.

The surgery would repair her deteriorating vascular system, the thin-walled heart chambers, the weakening muscles in her chest. But Madame Ruxton would never feel young and healthy again, regardless of how many operations she underwent. He saw her standing there in his home-body, eyes still glittering. A calculating expression pinched his familiar face.

For the first time, Eduard felt uneasy.

His body ached so badly that he welcomed the anesthetic. He saw his own physique—Ruxton's, for the time being—shifting and distorting behind rheumy eyes that no longer clearly saw the world.

Eduard heaved a deep breath, felt the symphony of pain in his sunken chest and lungs, then drifted backward into chemically induced blackness. . . .

VI

In full uniform, Daragon went to the business offices of the person who now owned the brother's original body that had gone missing years before. The current owner was a public relations specialist who dealt with celebrities. His name was Stradley, and he called himself a "hype-meister."

As Daragon waited in the reception room, he glanced at the receptionist, who shrugged toward the door where Stradley sat "in consultation," though Daragon had no idea with whom. Finally, the exuberant hype-meister burst out of his office wearing a grin, but the falseness of it wore off in a moment. Daragon had seen pictures of the missing brother's home-body and recognized it immediately.

The hype-meister just scowled. "So,

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what does a Beetle want in my office? You guys certainly don't need *my* help with publicity. Of course, maybe the BTL could use a bit more favorable coverage."

Daragon didn't rise to the bait. "That's not why I'm here, sir."

Stradley crossed his arms over his chest. The hype-meister wasn't taking good care of himself. His neck and face seemed slack, a bit jowly, and he had begun to grow a heavy gut. His eyes were bloodshot, his movements frenetic, as if he sampled too many stimulants, legal or illegal. Daragon hoped the body remained in good enough condition for the medical treatment.

"State your purpose," Stradley said. "I command high hourly rates, and I'll start charging, if you start wasting my time." Daragon wondered how the man would ever get a bill through the BTL's bureaucratic accounting systems, but he decided not to press the matter.

"We want your body, sir," he said. "Someone needs the loan of it—the sister of its original owner."

The hype-meister narrowed his eyes, trying to figure out Daragon's angle. "Why on earth is the Bureau messing around with a personal problem? Your mistress, maybe?"

"She needs DNA-matching therapy. You have the only body they can give the appropriate tests to. You have the genes, and they need to extract some samples."

"Not from my body they won't." Stradley raised his arms. "I'm a busy man with a burgeoning office here. This is *my* body now. You can check your records. I acquired it free and clear, permanent lease, a year and a half ago. And even then, that wasn't from its original owner. This guy has been bounced and bounced. Who knows how many other people have lived inside it? Now it's mine."

"Mr. Stradley," Daragon tried again, "the only thing I care about is who *presently* owns the body. That is you. You have the precise genetic match required. Can you find it in your heart to save someone?"

"I can't find it in my heart to give up what I'm doing here to have my body undergo long and excruciating medical work." They faced off in the reception area. Stradley made no move to invite him into the main office. "I need my body. I use it every day."

Daragon mentally searched through what he had studied. The law remained murky in this area: Stradley was indeed the legitimate owner of that body, and even former family members couldn't force him to undergo a medical procedure he didn't want to have.

Daragon folded his hands in front of him. "You've been in that body for a year and a half, sir. Perhaps it's time you switched with someone else."

"I can't afford a new body just at the drop of a hat—that's quite an investment."

Daragon continued, "I should put you in touch with the family. The parents and the sister may offer enough credits for a replacement body. You can swap out, so they have access to the DNA they need, and you can continue your work uninterrupted."

Stradley blew through his lips. "Might be acceptable, as long as it's a trade *up*."

Daragon nodded brusquely. "I won't take up any more of your time today, sir. I will provide the family with contact information and let them resolve this matter."

"No promises," Stradley warned.

As he left, before returning to the BTL undersea headquarters, Daragon knew he should check up on Eduard first. They had a lot to talk about.

VII

Nightmares later, Eduard swam back to consciousness, letting light fall through his eyelids and then into his weary eyes. His brain couldn't think.

But he could focus on people surrounding his bedside, the tubes and

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electronic monitors hooked up to his body, which was now one constant scream of pain, louder than before. His discomfort ranged from low moans in his arms and muscles, to a shout where the open chest wound had been sutured together. His heart felt different, repaired—but battered into submission, not as good as new.

Then he recognized his home-body across the room . . . and a dark uniform at the door, a man with black hair and almond eyes. Daragon!

Eduard's vocal cords were raspy and uncooperative from the heavy anesthetic as well as the weariness of innumerable years. "What . . . why are you here?"

Daragon smiled down at him, resplendent in his BTL insignia. "I just wanted to make sure nothing . . . uh, *accidentally* happened during your surgery." He flashed a glance over at the crowded lawyers, Ruxton's family members, and Eduard's home-body, who stood with shoulders squared, arrogant, head held high.

"Am I . . . was the surgery successful?" He tried to raise himself, but was unable to. His arms felt like wet balsa wood.

Daragon bent closer. "Oh, yes. I spoke to the doctors immediately before they operated on you. We encouraged them to make sure you pulled through. I believe your recovery will be a swift one." He turned, looking once more at the Ruxton cadre, all of whom only scowled back at him.

"Thank you, Daragon," Eduard rasped through the old woman's wattled throat. "It's good to see you again."

When the doctors said Eduard was healthy enough to sit in a hoverchair, Daragon returned to push him out of the room. He brought seven impressive-looking BTL officers with him. Forming a grim protective barrier, they escorted him down the corridors to where Ruxton's lawyers waited. Eduard did not like the look on Daragon's face.

Her attorneys already had more documents drawn up, but Daragon opened the conversation by saying, "He's healthy enough. The doctors expect a full and complete recovery. Eduard has done his part."

"I'm afraid my body's not yet entirely recovered," Madame Ruxton said, sitting imperiously in Eduard's form, drinking sweetened tea. Sitting in his wheelchair, Eduard wrinkled his nose. Personally, he despised sweetened tea.

One of the lawyers held forth a document. "We have here depositions from the medical professionals who have inspected—" He paused, then looked over at the withered woman in the hoverchair. "—who have inspected this body. This person still has severe liver problems, as well as the potential for total kidney failure within the next year. The pulmonary system remains at greatly diminished capacity." He held up the original paper. "Our signed contract specifically requires that Eduard remain in Madame Ruxton's former body until *full recovery*." The attorney gestured with a clean, manicured hand. "I'm afraid that what we have here is not 'full recovery,' by any stretch of the imagination."

Eduard felt cold inside, wondering if Ruxton's cronies had managed to outwit him. He'd been uneasy before about not getting his own attorney, but had blustered through with arrogance and misguided pride. He felt stupid, and he hated to feel stupid. He had been trapped by his own naiveté.

"I'm afraid that's not acceptable," Daragon said calmly, "and obviously beyond the intent of the original contract." The Beetles stepped around him, flanking Eduard in the hoverchair. They moved closer, intimidating.

Ruxton's lawyers crossed their arms over their chests in unison, like some sort of choreographed act. "We have the resources to tie this up in litigation for years, if necessary. Either way, Madame Ruxton will win."

"And the BTL has the power to impound all of her assets in anticipation of

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our eventual victory," Daragon countered. "I can cite numerous precedents."

Eduard blinked, without the strength to move or even to speak for himself.

"What you propose is unacceptable," Daragon repeated. "You'll swap back now."

He nudged Eduard's hoverchair forward. Madame Ruxton didn't move.

Daragon lowered his voice and withdrew a spray vial from a pouch at his belt. "You've heard of Scramble? A drug that breaks down your barriers and allows someone to swap with you, no matter how much you resist."

Finally Madame Ruxton flew to her feet and whirled, staring down at her weakened body in the hoverchair. "What've you paid them? I can double what you've offered. What kind of pull do you have with the Bureau?"

Eduard just shrugged his bony shoulders.

She snapped at Daragon and all the other Beetles. "I can pay you twice what he's paying you. Right now, in cash."

Daragon said, "Attempted bribery of a BTL officer is an actionable offense. We have a room full of witnesses. Shall I take you into custody now?"

A lawyer leaned close to her. "That was not very wise, Madame Ruxton."

"If you swap now with Eduard, perhaps we can forget the entire matter," Daragon said. The other Beetles pressed closer.

Teeth clenched, eyes flashing behind Eduard's familiar face, Ruxton sighed with enough vehemence that she spat out her breath. "Oh, very well!"

She leaned down to the hoverchair and touched her own temples. Eduard looked up at her with weak eyes, and it seemed as if she ripped his consciousness free and slammed it back into his own body.

Madame Ruxton sulked back into her wheelchair-bound form.

Eduard reeled, disoriented to be healthy and energetic again, but glad to have his home-body back. Each breath seemed like liquid honey in his lungs. His muscles tingled, so alive again, finally.

The attorneys guided the old woman's chair away, making excuses as she railed at them.

Daragon smiled at Eduard, then gestured for the other Beetles to leave them in private. Once they were alone, though, Daragon's face tightened into a scowl, and he no longer wore a victorious expression. "That wasn't the brightest thing you've ever done, Eduard. Why didn't you obtain your own counsel?"

Eduard did not even try to excuse his stupidity. "I assumed I knew what could happen. But I didn't imagine half of the contingencies. I was clueless."

"You were out of your league."

Eduard could not stop himself from grinning, touching a ghost pain in his chest from where the operation scars had been. "Do you know how much they paid me for that? I can survive for a year on those credits!"

"You almost didn't survive for a day. Ruxton's group had already tried to pay off the doctors." Daragon bent over, frowning with concern. "Is this the way you really want to live, Eduard?"

Eduard pursed his lips, thinking. "I'll just have to be more careful next time. Thank you very much. I owe you one."

Daragon shook his head, and said his brief, brusque farewells. Eduard drew a lungful of air and raised his head high, glad to be alive.

VIII

When he went for his weekly meeting with Mordecai Ob, Daragon wore his trim, neatly pressed uniform. The broad-shouldered Bureau Chief stared into the gas fireplace, where silent flames forever attempted to consume ceramic logs. Stacks of memos and summaries of investigations-in-progress lay piled around him. On a routine day, all aspects of the BTL would have fascinated Ob. But at the moment he appeared to have lost interest.

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"What's wrong, sir?" Daragon said. "Is there anything I can do to help?"

The Chief blinked at him in surprise. "Do you now have the talent to read into troubled matters of the human heart, as well as just spotting identities?"

Daragon stood at attention, keeping the grin off his face. "I just try to be perceptive, sir."

"My troubles have nothing to do with the Bureau." Ob picked up a printout and scanned it, but he was just fidgeting to distract himself. "Time to get back to work."

"Sir, all aspects of your life concern the Bureau—especially if it has any impact on your ability to function here."

"That sounds like something *I* would tell my best trainee."

"Your best trainee just said it to you, sir. What can I do to help?"

Using a control near the front drawer, Ob turned the flames down. "I've recently lost my personal trainer, and I need a replacement. Someone to exercise and keep me in shape. I'm not looking forward to the frustration and attendant difficulties. I've got enough to do." He flexed his arm, gripping the bicep. "I try to keep myself fit. I find it sharpens my mind. But I don't have time to do it myself."

Daragon considered, the wheels already turning in his mind. "What type of person, exactly, are you looking for, sir?"

"As I said, I'm proud of my body. I won't give it to just anyone." Ob folded his big hands in front of him, no longer making any pretense of working with the papers. "I need someone I can trust, someone to do that workout for me, so I can devote my energy to administering our great organization."

Daragon clasped his hands behind his back, standing tall. "Would you mind very much if we skipped our briefing for this morning, sir? I think I've got the right person for you."

Daragon waited in the open-air coffee shop. Dressed in his BTL uniform, he didn't find it difficult to keep an empty table or even empty chairs around him. He pulled up the dark sleeve and glanced at his watch. Already twenty minutes late. Eduard wasn't a punctual sort of person.

As the street outside hummed with a flow of people, he scanned the crowd. He had no idea what body Eduard would be wearing when he came, but Daragon used his ability of spotting personas to recognize his old friend just by his inner presence. He fixed his gaze on an old man hobbling toward the coffee shop—and made out the colorful core he knew to be Eduard, even without checking his ID patch.

Daragon waved to signal him over. Eduard approached with exceedingly cautious steps. His back was hunched, and his skin had a rough and leprous appearance. In his creaking body, he sat at the round table with a heavy sigh as if severing the puppet strings to his arms and legs.

Daragon shook his head in dismay. "Look at you. What are you doing to yourself?"

Eduard just waved a swollen-knuckled hand. "Some old guy had a hot date. Limited term. I'll get my own body back this evening."

The waiter came over, waiting for their orders. Daragon chose a spiced drink and looked at Eduard, who asked for a warm herb tea. "This body can't handle too much caffeine. The digestive system is pretty much shot."

"Eduard, you can't keep doing this to yourself. How often do you hopscotch? How many times a week?"

"Depends on how many clients I get."

Daragon leaned forward conspiratorially. "Listen, let me suggest something so much better for you."

Eduard crossed his liver-spotted arms over his skeletal chest, annoyed at the scolding. "Yeah, right. I've been thinking it's time to move on again, before I get too bored. Find the next phase in my life. But I'd rather not be turned into

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some kind of experimental subject for the Beetles."

Daragon stiffened. "Why do you see only bad things about the Bureau? We watch out for abuses of power, spotlight the dangers inherent in unregulated hopscotching." Even to him, it sounded like a rehearsed speech. "Downtrodden people are too tempted to sell their bodies, their lives."

Now Eduard bridled. "Like me, you mean?"

Daragon gave him a hard look. "You were glad enough for my help with Madame Ruxton's lawyers."

Eduard pursed his lips, softening his voice. "Granted. Sorry if I insulted you. But no matter how close you observe everybody, you can't stop all the scams." He held up his hand to show the filmy rectangle of the ID implant. "These things are too easy to thwart, if somebody is willing to risk enough."

The waiter came with their drinks, and he picked up his tea with shaking hands and took a quick gulp. Daragon looked at Eduard's decrepit body with barely concealed dismay. "Please let me make you an offer. It's an opportunity I think you'll like."

Eduard watched skeptically while Daragon outlined his plan with rising enthusiasm. "Wouldn't it be better than nearly dying for someone else? Better than being sick all the time in someone else's body? Undergoing surgery for a coward?"

Eduard sipped his herb tea and sat back with a heavy sigh, trying not to show how much this crumbling body pained him. "All right, I'll hear what this Mordecai Ob has to say, and make my decision based on the merits alone." He pressed a hand to the small of his back as he stood up. "Doing this crap is getting to be a pain."

Daragon heaved a huge contented sigh. He gestured to the frail old man Eduard wore. "Mr. Ob cares for himself very much. Even though he's incredibly powerful, he still lives in the same body he was born with. He could have bought a new one a thousand times over, but instead he'd rather keep his own."

Eduard looked at the wrinkled parchment flesh on his wrist. "See me tomorrow. I'll be myself again."

After the hydro-skimmer landed on the big oil-rig platform, Eduard looked around in the sunlight. The salt wind ruffled his hair. "Nice place. Not much of a tourist attraction, is it?"

"You're very lucky to be coming here," Daragon said. "The Bureau rarely allows outside visitors. I had to get special permission for you."

Eduard pretended to be impressed, but Daragon wasn't fooled. He just hoped his friend would make a good impression on Mordecai Ob. Down in the richly decorated office, the Bureau Chief had cleared his desk, turned on the fireplace, and set out a plush overstuffed leather chair for Eduard's interview.

Ob extended a large hand and took Eduard's grip. "Very pleased to meet you, Eduard." He gestured for the guest to sit in the leather chair. "Daragon tells me I should hire you as my new personal trainer. So far, I have found his advice to be invaluable."

Daragon's heart swelled. Eduard made himself comfortable in the creaking leather chair. He crossed one leg over his knee, brushed the smooth armrest. "So tell me what this position entails. It sounds interesting from the way Daragon describes it."

Ob put his elbows on his desk. "You'll be my 'caretaker.' I insist on remaining in shape, but I don't have the time to maintain the necessary effort. Your sole job will be to spend several days a week exercising my body. That's all. You will go jogging and swimming. You'll do calisthenics, you'll eat healthy food. Meanwhile, I'll spend the rest of the business day in your body and get my work done."

Eduard played the tough negotiator.

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"And the pay will be . . . ?"

"Substantial. I'll also give you guest quarters to live in on my estate. You'll be fed and clothed, but you must be at my beck and call at any hour."

"That's a tall order."

Impatient, Daragon replied, "Eduard, look at the other work you've been doing. You couldn't get a better job than this."

Eduard touched his chest, his arms, and took a deep breath, clearly pleased with how his own body felt. He gazed across the polished desk and noted the older man's muscular physique. "Yeah, it *would* be nice to hopscotch into someone whose body I'd enjoy living in, instead of just gritting my teeth until it's time to swap back."

"Absolutely," Daragon said. "This is a great deal for all concerned."

Eduard and Mordecai Ob shook hands, consummating the arrangement.

IX

Eduard perspired heavily in another man's body—but this time he enjoyed the sensation, an exhilarating workout instead of a miserable fever.

Warm sweat trickled out of his close-cropped salt-and-pepper hair, down his cheeks. Mordecai Ob's strong heart pumped as he exercised, the blood flowed, the muscles strained. As Eduard panted, fresh air burned in his lungs. According to the clock and his employment contract, he still had another hour of calisthenics before Ob would be satisfied with the workout.

He stood under the overhead lights in the exercise room. Two walls were plate-glass windows that looked out onto the well-tended gardens and paths; two walls were floor-to-ceiling mirrors in which he could watch his muscles ripple, see how he exerted himself.

Eduard gulped half a bottle of water and toweled off the sparkling sweat. Then he tugged a sweatshirt over his head, plucking at the thick cloth where it stuck to his skin. He already wore running shorts, good shoes. Ob had taken care of everything. Eduard just had to do the time-consuming work.

He waved his hand at the sensor, and the window skated aside. He puffed two breaths like small gunshots, preparing himself, then set off at a fast jog in the fresh air and morning sunshine. . . .

In the past few weeks, Eduard had settled in at the expansive estate. He did Ob's workouts, and he took his generous pay. Ob didn't require much, though he occasionally asked to swap at odd hours, without explaining his intent. *Some shady Beetle stuff*, Eduard supposed. He really didn't care. It was part of the job.

Ob didn't want to be friends, just business associates. He made sure Eduard didn't make himself too obtrusive in his daily life. In fact, Eduard rarely saw the man except to swap in the early mornings, then back again in the evening.

Now, jogging around the estate, he listened to gravel crunch under his shoes. He fell into a rhythm, a pace he could never have matched in his own untrained body, and jogged along a circuit that encompassed two miles. He ran around hedges, through a quaint shrubbery maze copied from an old English manor.

As the path wound through Ob's extensive rose garden, Eduard raised a hand to wave at the huge Samoan gardener, Tanu. The immense man's upper arms were as wide as most people's thighs; his skin was dark and dusky, as if impregnated with the dirt in which he always worked. Tanu had a mane of charcoal hair like something a sword-and-sorcery barbarian might have worn.

But Eduard knew the Samoan was friendly and good-hearted, though he frequently averted his large, dark eyes. Tanu spent most of his time alone with his flowers and shrubbery, trellises and hedges. He not only talked to the plants, but seemed to listen to them as well.

As Eduard jogged past, waving, Tanu

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raised a hand the size of a boat oar. Eduard had tried to strike up conversations with the gardener, but the dialog was mostly one-sided. He glanced over his shoulder, still trying to get a reaction from Tanu.

Not looking where he was going, he stumbled against one of the rose bushes. The thorns made a long red scratch down his right thigh, but Eduard recovered without missing a beat. He glanced down at the rose bush, but saw no obvious damage.

"Sorry!" He brushed off his legs, then sprinted onward.

Another mile to go.

At the end of the work day, when Mordecai Ob returned home, Eduard went to meet his employer as the man set down his papers and documents in the holding area by the door. He looked weary and drained, his expression covered with a blanket of stress. Impatient, Ob gestured him forward. "Take your body back. I want to feel refreshed again."

They hopscotched, and Ob took a deep breath and smiled, glad to be "home," while Eduard experienced disappointment in his own form again. The muscles felt stressed and ragged, without the clean energy of a rigorous workout. Ob had left him with a tension headache in the back of his skull.

As Eduard rubbed his stiff shoulders, Ob stood in the middle of the foyer, touching himself, taking a bodily inventory. Before long, he discovered the scratch on his leg. He rubbed it, scowling, his skin flushing. "What have you done?" He undid his pants and reached under the fabric to feel the wound. "What's this?"

"I scratched it on one of the rosebushes during my morning jog. Just an accident."

"I don't want to hear about any more accidents!" Ob glared with intense, chestnut eyes. Eduard's muscles seized up in an unconscious panic reaction. He could tell why this man was so successful among the Beetles.

"Okay, okay—I'm sorry! It's just a scratch." After having undergone near-fatal open-heart surgery, Eduard couldn't summon much sympathy for a ridiculously minor blemish. "It'll heal before you know it."

"Eduard, I have entrusted you with my physical being." Ob's voice was low and threatening. "If you can't take better care of my body from now on, I won't need your services any longer."

Eduard struggled to keep his temper in check. This job was too much a gravy train for him to let it go in a fit of pique. "I . . . I'll be more careful from now on."

Ob didn't answer as he indignantly strode to his chambers.

X

Daragon stood in the Chief's office, still bemused to see his friend's familiar features sitting behind the massive desk. "It's been two months, sir. I take it everything is satisfactory with Eduard, then?"

"He's adequate, though occasionally careless." The Chief took a deep breath, all business now. "You have accomplished all the tasks I have laid out for you. Now it's time to put your knowledge to work, in a practical manner." Ob leaned back against his desk. "Is there anything you'd like to know? Any mystery you'd like solved? A particular obsession you've had? I'm giving you the full resources of the Bureau to take on your pet project for a few days. Think about it."

The artificial fireplace in front of the desk hissed and crackled with sound effects. Daragon mulled over the question, but the answer was immediately clear to him. "I'm going to locate my mother or father, sir. I've never known who they were."

Even from the days of his youth, Daragon had been intrigued by the identity of his biological mother and father. Why had they abandoned him to the or-

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phanage? What secrets did they hold? Did his family already have too many brothers and sisters? Were his parents poor? Were they also unable to hopscotch? Did they have the mental handicap like he did?

Ob let out a quiet laugh. Ostensibly, this project would hone Daragon's identification and location skills, but the Bureau Chief did it because he liked his student. He waved Daragon toward the door. "Go ahead, then—indulge yourself."

Daragon grew accustomed to the strange smells inside the cool, humid chamber. He waited for his eyes to adjust to the only light the grotesquely stunted Data Hunters seemed to require. He heard the recirculators, the bubbles of life-support fluid. "Jax, are you there?"

One of the fishlike embryos stirred in its harness. Cables trailed from his eye sockets, connecting the creature's optic nerves directly to the computer/organic matrix. "Ah, Inspector Daragon! And I'm glad to see that it *is* Inspector now, Grade II even. A promotion due, no doubt, to my brilliant assistance?"

"In part."

"A large part, I suspect. But whatever it takes to get you to come in and chat. What can I do for you today?" The stunted body swayed, but the voice that came from the speaker was animated, jovial, and good-humored.

"How good are you at finding missing parents?"

Jax groaned melodramatically. "Oh, not *that* tedious question again! Let me guess—Chief Ob gave you your first independent assignment?"

Daragon flushed. "I take it you've done this kind of search before?"

"And succeeded admirably, I might add."

He laughed. "So I take it that success is practically assured?"

"Not a chance. You don't understand the complexity of your question. Let's just start with your mother—*who* is it, exactly, that you want me to find? Do you want to locate the biological body that gave birth to you? The womb inside which you gestated, the vagina you slid out of—no matter who's living inside the head these days?"

"The body won't tell me anything. I want to meet the *person* who made the decision to give me up. I want to talk to the woman—"

"—or man," Jax interjected, "if they swapped sexes. Never can tell."

Daragon sighed. "I just want to have a conversation with the person who decided he or she didn't want to be my parent."

"That's clear enough, I suppose." The Data Hunter's body turned toward him, though Jax could be watching from any number of optical sensors. Jax swiveled his eye cables toward the COM nexus in the dim chambers. "Tell me, Inspector Daragon—what's the big deal? Why do you care so much?"

"It's personal," he answered, his voice quiet and a bit hoarse.

"Hey, this is a discretionary task. You're asking me to bust my figurative butt to track down information for you—don't you think you owe me an explanation?"

Daragon sighed. The hardest part would be explaining it to someone else—especially to a half-human creature who had no direct experience with the real world. "In the orphanage, I used to read books by Charles Dickens. He was an old classic author—"

"I *know* who he was, Daragon." Jax's voice sounded impatient.

"Of course you would. The tales were compelling, people from other times, with problems and concerns so different from ours, but still the same. Especially when someone read out loud, it was a magical experience, like an old storyteller around a campfire. Very primal, the core of what fiction is all about—not fancy language or convoluted metaphors . . . just solid, interesting

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stories."

"*And* . . . ?"

"Why the rush? I thought you enjoyed conversation?"

"Only when it has a point."

He heaved a breath. "I enjoyed *Oliver Twist* the most. It raised the question of whether a simple boy without parents and without a bright spot in the world might be an unrecognized prince. Oliver didn't know his birthright, thought he was just an unremarkable orphan—and after a series of adventures, he found that he was much more than he seemed."

Daragon flushed in embarrassment as a staticky chuckle reverberated through the speakers. Jax said, "So you think you might be the heir to some great fortune!"

"I knew you wouldn't understand." Now that he heard someone else say it, the thought seemed ridiculous. "I just want to know."

"Good enough," Jax said brightly. "I can always tell honesty when I hear it. Therefore, I agree to search relentlessly for your parents. But on one condition."

Daragon groaned. "Not again."

"Hey, nothing's free."

"What is it this time?"

"I want you to read *Oliver Twist* out loud to me."

Daragon crossed his arms over his new uniform. "But you can download the whole text anytime you want to. Isn't that more efficient?"

"In its own way, but downloading isn't the same."

"You're probably right," Daragon said, and agreed to the terms.

XI

Morning in the mansion, time to exercise again. Another day at work.

The sheets retracted, and Eduard crawled out, aching. His muscles were sore, even his bones felt somehow bruised. "I should take better care of my own body instead of just exercising Ob's all the time." He wanted to remain in bed, but he didn't have that luxury. Not today, not any day.

Worse, his mouth tasted awful, as if Mordecai Ob had eaten cold squid and garlic. He rinsed with a strong mouthwash, but the foul flavor lingered. On mornings like this, Eduard gladly traded bodies with the Bureau Chief.

Out in the main conservatory, Ob sat in a white wrought-iron chair eating his breakfast. Eduard reported for duty, dressed in a nice suit, just in case Ob needed to go into BTL Headquarters.

"Have you eaten yet?" Ob hadn't bothered to change out of a thick bathrobe. "I'm going to need the energy for a long day."

"Sorry." Eduard bent over to the fruit plate and wolfed down some pineapple and bananas.

"Enough." Ob gestured impatiently, and the two men hopscotched. After his stiffness and pains, Eduard breathed a sigh of relief to be in a fit body. The Bureau Chief bustled out of the conservatory without saying goodbye, in a hurry to be off to work.

Eduard sat back down in the white garden chair, wishing he could enjoy the remaining breakfast on the plate—but Ob had already eaten his fill, and this body was no longer hungry. Now Eduard had to run it off.

As he went into the gym to change from the bathrobe into exercise clothing, Eduard reminded himself that he was pampered here, living in a mansion with all the food and comfort he could want . . . and he only had to do a few hours of exercise in a fine-tuned physique that *enjoyed* the physical workout. No problem.

Daragon came to visit the estate once every few weeks, ostensibly on a work-related errand. The BTL Chief was pleased with Daragon's work, and Eduard was happy for his friend. But he felt separated now, a servant who shouldn't engage in friendly chit-chat with a uniformed Inspector.

Eduard had plenty of quiet time to

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himself, though he was growing more and more dissatisfied. He often felt ill-used when he swapped back into his own body, sore and tired. He frequently had that foul taste in his mouth, and he couldn't understand why. What was Ob doing to him?

Moving furtively in his own mansion, Mordecai Ob locked himself in his study. There would be time to go to BTL Headquarters later. He looked out into the leafy covering of hibiscus vines draped across the window; the foliage obscured his view, granting him the privacy he required. He couldn't let anyone see what he was doing.

As he prepared the items he needed, Ob let his mind wander. He was proud of Daragon, and he hadn't felt that way about a trainee in a long time. He worried how Daragon might react once Eduard was no longer useful, but by that time, the young Inspector would be so wrapped around Ob's finger that it wouldn't matter anymore. The Bureau Chief wouldn't be able to keep his secret forever. But he could last longer than Eduard. . . .

So far, Daragon had restored some exhilaration to Ob's work. With the BTL running so smoothly, he had wondered if he could ever experience that excitement any more. He recalled when he himself had been so enthusiastic, so full of energy, so driven to do his work. But those days were long gone, swallowed in cynicism and boredom.

He ran the powerful Bureau of Tracing and Locations; he had more money than he knew what to do with; and he felt as if he was doing a great service by apprehending criminals, finding fugitives, and reuniting families. However, as with so many celebrities and politicians who had everything they could possibly want, ennui had set in several years ago. Ob looked for ways to enjoy life again, challenges to face . . . or at least some sort of stimulus.

It was then that he had fallen into the trap of Rush-X.

The potent, illegal drug was distilled from an extract of shellfish found off the Yucatán coast, a glistening powder like crushed pearls suspended in a glycerin solution, meant to be delivered under the tongue. BTL investigators had tracked down a major manufacturer of the drug, and the samples had come to Ob as evidence.

Over time, Rush-X caused a body to disintegrate, scrapping the neurons so that muscular control fell apart. Despite its known hazards, people paid enormous amounts and risked their own health just for the stimulus the drug provided.

At the time, Ob hadn't understood why.

When he had so much of the drug available to him, entrusted to him, Ob—against his better judgment in a moment of intense boredom and indecision—felt adrift. One dose couldn't cause significant harm, or so he'd hoped. The inventory had already been documented, and all the samples were to be incinerated. No one would question him, no one would notice a slight discrepancy.

Before he could change his mind, Ob had placed a vial of the pearly liquid under his tongue. He broke the thin gel capsule, and the drug penetrated soft sublingual tissues. At first it tasted awful, fishy and spicy, like squid and garlic, mixed with cleaning fluid.

Then the effect hit.

The experience was amazing. Though he had been bored and depressed, now his mind opened. He *cared* about things again. He was energized, exhilarated. In only a few seconds Mordecai Ob rediscovered a passion for life.

Later, because of his connections with the Bureau, he was able to get his hands on Rush-X often enough to keep his habit going. The contraband drug was destroyed weekly, and the Bureau Chief could "inspect" it whenever he wished.

But Ob had seen dying Rush-X ad-

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dicts, and vowed never to let that happen to his own body, to let himself waste away for chemically induced thrills. Then he'd remembered his personal caretaker, and a solution came to him. . . .

That had been years ago, and the glamour and drama of Rush-X had never grown old.

Now, inside Eduard's borrowed body, he leaned back in a padded chair inside his locked office. He cracked a vial of pearlescent frozen fire under his tongue . . . just the precise amount. He rode the racecourse of energy that burned destructive flames through Eduard's flesh. As the euphoria hit, a smile froze on his face.

As he finished his jogging circuit of the grounds, Eduard came across the quiet and introspective gardener. The massive Samoan wrestled with an ornamental tree, digging his feet into the ground and trying to heave it upright so he could lash on a support strut. His arm muscles bulged, but he managed to prop up the support long before he exhausted himself. Finished, Tanu straightened the bindings and touched bent branches, like a fussy mother tugging the collar of her son's shirt.

Eduard stopped short, wiping sweat from Ob's forehead. He had made up his mind to ask an important question. Swallowing thick phlegm in a burning throat, he strode over to the gardener. "Tanu, you've worked here for a long time, haven't you? I need to ask you something."

The Samoan turned to him; his expression was open and uncertain. "Years," he said, his typical extensive conversation.

Eduard jogged in place to cool down. "You must see a lot of things going on around here at this estate."

The Samoan looked at him with sad, dark eyes. He nodded, then found the Japanese maple beside him intensely interesting. Tanu plucked a small leaf off a branch. Finally, after a long moment, he said, "You're not like the other ones."

Eduard raised his eyebrows. "Other ones? You mean Ob's previous trainers? How many have there been, besides me?"

Tanu looked longingly back at his trees. "Some."

"What happened to them?" Eduard couldn't imagine why anyone would give up such a plum of a job.

"They're gone."

This conversation was harder work than two hours of exercise. "Care to tell me about any of them?" The gardener refused to explain what was going on. "Well, I'm here to stay."

The Samoan looked back at him, dark eyes filled with infinite sadness.

XII

Daragon set out, armed with information and a set of thin active-screen images. For the first time in his life, he knew what his real mother looked like (at least what she looked like today). The woman lived in a much younger body now, and spent a great deal of time in a place called Club Masquerade. He could see her face to face—if he could maintain his nerve.

As he stood in front of the Club entrance, Daragon took a moment to fuss with his appearance. He had worn nondescript clothes—a BTL Inspector's uniform would never do, not for this. Before heading out to the streets he had spent long minutes looking at himself in a mirror. He wanted to make a good impression.

He stepped inside the Club and stood motionless. Feeling wobbly, he scanned his handful of surveillance images again, though he had memorized every line in her face. *His mother's face*, though she couldn't possibly bear any physical similarity to him anymore. Maybe with his special vision he could see a similarity in her soul, a family resemblance.

The floor of Club Masquerade was a sea of people, lights, and music. He

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couldn't imagine how he'd ever identify a single person in the midst of such chaos, so many minds and gyrating bodies, each one able to swap at will. . . .

Then he spotted her, as if a telepathic link already existed between them.

She sat alone, waiting, available. Under the changing bath of lights, his mother looked healthy and sexy, flushed with a sheen of glitter and spray-on pheromones. She nibbled on a stimstick, legs crossed on a floating stool as she hung by the bar.

Daragon stood frozen, watching her for a moment. He could see her aura, her identity, recognizing a flicker that bore connections to his own. He noted details in her *self* that were obviously related to him. This was her, no doubt about it.

With a bored and impatient expression, she scanned the people on the floor, looking for no one in particular—but definitely looking for *someone*. She leaned back languidly, tossing ginger hair over her shoulder.

Daragon marched up to her before his resolve could fail. He drew on all the confidence and firm body language he'd been taught in the BTL. He knew how to confront violent fugitives, but this seemed even more intimidating.

His mother's eyes locked with his. Her mouth tightened, then smiled as she appraised him. "Not a hint of hesitation." She flashed a hungry smile. "You look like you know what you want." She sat straighter, close to where he stood nonplussed. She wrapped her arms around his neck, to draw him down for a kiss.

"I—I just wanted to find you," Daragon said. He paused a beat, took a deep breath. "You, you're my mother."

Her bemused expression froze, then fell into a scowl. "What did you say?"

"I'm your son, but we've never met. You gave me away as an infant—" His words came in a rush.

"*That* baby? Ah, that was a long time ago."

"I've always wondered about you. I wanted to know who you were, what you were doing. My own mother. I tried to track you down."

"For what?" She was unimpressed. "That child came out of a different body. What does that matter to me?" She ran her fingers over his wrist, still trying to grasp his hand. Maliciously, she seemed more determined than ever. "It shouldn't matter to the two of us right now."

Daragon withdrew, but she slid off the floating stool, more aggressive. She kissed him, quickly and passionately, on the mouth. Daragon backed toward the dance floor, but she followed. "Stop! I just wanted to talk to you."

"Why? Now you've got me intrigued. If you want us to get to know each other, I can think of a better way. What was your name again?" She pressed against him, rubbing hips and pushing the spongy firmness of her breasts against his ribs. "Don't you think this body is sexy? It's new, and I paid good money for it."

"But you're my mother!"

"Kind of kinky, isn't it?" She laughed at him, made him feel small. "What are you worried about? Incest? That was an old, genetic-based taboo to prevent inbreeding. Nothing to worry about here." Her voice got huskier. "Hey, not many people have a chance to try out something like this."

Daragon stopped resisting and stood firm, remembering what Ob had taught him, remembering that he was a BTL Inspector. He couldn't let this woman dominate the conversation. This was *his* encounter, and he could take the lead.

"Stop being so immature!" he snapped, using a voice of command. "You're supposed to be more of an adult than I am."

She laughed. The music kept playing in the background, growing louder. People talked and chuckled, milling about. "It's obvious I'm older, yes. Today, someone else has the flesh that gave birth to you, and by now it's old. But you and I

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can still get it on, right now, just like two young, virile people."

"I don't want to have sex with you, Mother. I want to know about you, know about my father."

He could see bright recollections parading behind her retinas. "You might find it surprising, but I do remember the man who was your father—a very special man. We only had one night, and I could never find him again . . . but then disappearing is what he was good at."

She pulled Daragon closer so she could whisper in his ear with a hot breath that smelled of the spicy stim stick. "Your father's been alive for a hundred years, hiding, swapping bodies every so often, staying out of the spotlight." She chuckled. "But I guess he liked to get laid every once in a while."

Daragon could barely believe what he was hearing.

"You'll never find him," she continued. "He knows how to vanish, and it's been years. How long has it been, anyway? How old are you? In fact . . . what did you say your name was?"

"I'm Daragon. I'm twenty-two." Bitterness crept into his voice, resentment that his own mother had to ask him such questions.

She had managed to maneuver him out onto the dance floor. "I just want to stay young as long as I can—your father taught me that. Keep swapping bodies, keep yourself alive, trade up whenever you can. Is there something wrong with that?" She tried to press close, but now Daragon just wanted to be far away from her.

"Well, *I* don't have that option, Mother. I can't hopscotch at all—I'm an anomaly. I have to make do with what I have." He finally pushed her away. "With what you gave me."

"That was some other body. Don't get hung up about it. We can still—"

But Daragon turned and marched out of Club Masquerade, his hopes and illusions shattered.

XIII

Outside the window, the gardener's trowel chopped, chopped, *chopped*. Each blow pounded like thunder through Eduard's splitting skull.

He rolled off the narrow bed, feeling his muscles ache, his intestines twist as if he had the mother of all hangovers. The afternoon sunlight hurt his eyes, piercing his pupils like little spears. Mordecai Ob had returned at midday asking to hopscotch back into his own form, and now Eduard felt so bad he had no choice but to take a nap, sleep it off.

Or try to.

Tanu worked in the flowerbed under his window. Just weeding. He might as well have been using a jackhammer.

Groaning, Eduard stared at the ceiling for several minutes until he stood up, trying to fight the wave of nausea. His ears rang, and a film of sweat broke out on his forehead. He must be afflicted with some kind of slow-acting flu. Eduard remembered selling his body, enduring all kinds of agony for a few credits. He could get through this, too. He just wanted to know what it was; then he could put it out of his mind.

He had already run a viral and bacteriological scan to see if he was getting sick, but he found no infections, no cold. And this didn't have the same *feel* as the severe illnesses he had endured. Maybe Ob would let him go for a thorough medical scan, a professional assessment.

He looked forward to when he could swap into the boss's body, just to feel healthy again, for a change. He staggered over to the window and waved his hand to shift the polarized curtain film. Below, Tanu worked shirtless in the soil of a petunia bed. Normally at this time of day Eduard would have been up and around, reading or playing games.

Sweat trickled like oil down the gardener's bronzed back. He dug up old flowers, clearing the colorless bed for new flats of bachelor's buttons and phlox. Sensing the scrutiny, Tanu

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looked up, blinking in the afternoon sunshine.

Eduard stared through the window, seeing his ghost reflection: His own eyes were sunken, shadowed with pain, and his cheeks were gaunt. He wasn't doing well at all. When he pushed the controls to open the window, he noticed his hands quaking with an involuntary tremble. They'd never done that before.

"I didn't know working with flowers could be so loud." He rubbed his temples.

Tanu looked at him for a long moment, then hung his head. "It's happening again." He gathered an armful of the wilting petunias he had just uprooted.

Eduard leaned out the window, but the smell of the fresh air and plants and soil made him queasy. "What? What's happening again?" Tanu trudged away toward an enclosure where he dumped his mulch.

"Hey, Tanu!" The desperate sound in Eduard's voice struck a chord in the gardener, because he slowly turned around. "What happened to Ob's other physical trainers? Why did they quit this job? I need to know."

The Samoan shook his head; the rustling petunias quivered in his arms.

"At least tell me who the last one was. What was his name?"

"Sandor, his name was Sandor Perun. But he never took the time to talk to me, like you do."

No matter how much Eduard pleaded, Tanu refused to offer any further details and went back to his gardening. But now at least Eduard had a name to track down, a place to start.

Eduard took several potent analgesics, stood under a gushing hot shower until he felt refreshed enough to tackle his questions. He went the main COM terminals in Ob's mansion. Time to do a little hunting.

On the interactive filmscreen he searched through the jungle of information, trying to track down Mordecai Ob's previous personal trainers. Any connections with the Bureau and BTL business were naturally restricted, but the workings of Ob's private estate should be subject to the same COM-accessible requirements as any other piece of public information.

Sandor Perun. Eduard found a subset of data behind several pseudonyms and translucent filenames. First step, clear. He opened up the relevant information on employment at Ob's estate, searching for the man's hiring history.

To his astonishment, he uncovered a recently placed posting for a new job. His own job. *He's already looking for a new physical trainer!* Without saying a word to Eduard, Ob intended to replace him. He glanced at the interview notice, read the words. Identical job description, identical pay; starting time, "in the near future."

"You bastard," Eduard mumbled.

Working through the computer network, he then found the previous employment listings, his own file—and then the file for Sandor Perun. But that wasn't all: Before Sandor was Janine Kuritz, and before her was Benjamin Padwa.

When Eduard tried to uncover details of these former employees, he found no further record. No information at all. COM had no listings of what they had done after leaving service here. Even their medical records had been entirely cleansed. But Eduard had sketchy leads, and continued for hours, obsessed. Anger and ice grew inside him.

He didn't know how long it would be until Ob returned, and he didn't want to let his boss know he had discovered the secret treachery. Furious, his fingers like knives, he stabbed at the keys and erased his search.

His own body felt like hell, growing worse every day. Was it some mysterious ailment or poisoning? Had the previous trainers suffered the same thing as he was feeling now? What was going on?

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Everything about this too-good-to-be-true job, everything about this estate, seemed grim. Eduard didn't dare trust anyone but himself until he found some answers.

XIV

Another morning. As he settled into Eduard's home-body, Mordecai Ob stood scowling. He flexed the sore, weakening muscles and tried to mask an expression of bone-deep pain. In a voice dripping with disappointment, he said, "You feel like crap."

Eduard's look of relief at being inside Ob's healthy body annoyed the man even more. "I don't know what it is. I'd hoped it would get better by now. And the awful taste in my mouth—"

"It's your problem, Eduard, not mine," Ob said with a scowl. "You're getting to be a liability to me. Your exercise and body-training work is satisfactory, but it's hard for me to concentrate when I'm in a body that feels this bad." He still hadn't had the guts to confess that he'd been looking for a replacement trainer.

Eduard didn't know what to do, didn't know what to say. The Bureau Chief sighed in disgust and shooed him out of the study. "Go on! You've got a workout to do. Make sure that I feel good when I come back home. I have an important teleconference meeting that requires a great deal of privacy. Don't disturb me."

Eduard departed, trying to hide the flare of anger in his eyes.

Ob sealed the door to his private sanctum, leaving himself with a view of the leafy screen of hibiscus vines that covered the single window. Using Eduard's trembling hands, he popped open the bottom desk drawer to reveal a velvet-lined case of small vials, each one a concentrated dose of Rush-X, confiscated from the drug-incineration protocol. Every vial contained astonishing ecstasy, a powerhouse of sensations that made a jaded and tired Bureau Chief feel alive once again.

Eduard had been his addiction-receptacle for a long time now, but the young physical trainer was nearing the end of his usefulness. Ob had reconfigured the ampoules to increase the dosage; Eduard's body had grown so accustomed to Rush-X that he needed more and more of the drug to give him a full fix—but he had reached the limits. A larger amount would be quite dangerous, even for a body that had already tolerated so much.

Once again he shuddered with the horror of what might have happened had he used the drug in his own body, instead of a surrogate like Eduard. Ob knew there was a chance he might get caught, and so he had used his full resources to set up the trainer to take a fall. He had even planted several vials of Rush-X and related paraphernalia in Eduard's quarters, which Ob could conveniently find, if necessary.

He withdrew the fragile vial and held it. The delicate, dissolvable gel that held the pearlescent liquid would break in his mouth, letting the vibrant fluid dribble under his tongue. Eager, he raised it to his lips.

Then the video screen rang on his desk, demanding his attention. The tone was so loud and sharp that his jittery fingers nearly crushed the ampoule. Regaining his composure, Ob hid the small vial from view. His mouth was dry.

As the COM screen focused, Inspector Daragon's image stared back at him, attentive and expectant. The dark-haired man was neatly dressed, his dark uniform freshly groomed and pressed. Daragon always took his appearance so seriously. His almond eyes were flinty and severe.

"Sir," he said without waiting for a response, "you and I had our caseload meeting scheduled for this morning. I'm in Bureau HQ, but I understand you're working at home today. Would a teleconference discussion suit you instead?"

Ob controlled his surprise; he had

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been so intent on the morning's drug fix that he'd forgotten entirely about his scheduled meetings. "I apologize for not being there as promised. I've been very busy here and needed to handle several urgent matters from home."

"I understand, sir." His voice was so calm, his demeanor so professional. Ob wondered what he had done to engender such loyalty. Daragon was probably the best of the lot, the finest achievement the BTL could hope for. It made him ashamed to realize how far from the mark he himself had fallen.

Concisely, Daragon summarized his cases, updating Ob on the progress in numerous fugitive hunts and investigations. Ob pretended to listen, tried to keep his face an interested mask while the back of his mind clamored for the drug. He felt the slick ampoule in his sweaty fingers. Would Daragon never finish? *Why did he take so many cases, and why did he have so damned much progress to report?* Ob fidgeted in the chair.

Finally Daragon summed up, then hesitated. Ob pursed his lips impatiently. "Is there something else, Inspector?" Perhaps the sharp edge in his voice would turn Daragon away so he could be alone again at last.

"Sir, I have to comment. You're not looking at all well. Eduard's body seems to be experiencing severe medical stress."

Ob's shoulders slumped. "I'm sorry to inform you that your friend just isn't working out very well." He raised a hand, palm up, to cut off excuses or pleas. "He exercises well and does his job. Unfortunately, he just doesn't take care of his home-body with the same dedication, and I have to deal with this discomfort." He looked somberly at the screen. "I've given him every possible chance."

Daragon frowned. "I understand, sir. I'm very concerned about Eduard. Have you taken him to see specialists?"

"He says they can't find anything," he lied. "And I'm afraid I can't put up with it anymore. I've already hired his replacement. My new personal trainer starts in a few days. I do hope Eduard recovers from whatever personal problems he has, but I've simply got too many vital Bureau duties to tolerate this kind of distraction."

Daragon nodded crisply. "I see your point, sir. I had counted on him to do better. I hope you aren't upset with me for bringing Eduard to your attention."

"It was nothing you could have predicted. Sometimes people just . . . let you down." Ob reached forward to the screen controls. "Now, if you'll excuse me. I have important matters before me."

"Yes, sir." Daragon dutifully signed off.

Ob clawed at the vial in his hands, opened his mouth and slipped it in. His jaws cracked down—and the blessed flood of inspiration soared into his system.

While he jogged, Eduard wished the exhilarating feeling would never stop. Ob's muscles felt so strong, so well conditioned. In the evenings, the constant ache inside his home-body made him exhausted and sluggish. Eduard had been unable to function much beyond eating and sleeping and waiting for the next morning when he could live in Ob's body again. He didn't enjoy life anymore.

The night before, Eduard had stumbled out onto the walkway and fallen to his knees in the cool air as the wind rustled the tall blue spruces. He coughed and dry-heaved on the walkway. Though he turned his stomach inside-out, his guts produced nothing, spewed out no toxins.

Each day it had gotten worse.

As he huddled on his hands and knees in the darkness, he'd looked over to the gardener's brightly lit cottage, quiet and peaceful. Eduard considered going to Tanu, but he simply felt too bad. He couldn't present himself like this.

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Now, though, wearing Ob's homebody, everything felt right again. It reminded him of the way a healthy human being should function. He ran along the extended jogging course, beyond the "wall" where he ceased to concentrate on what his muscles doing. He entered a fugue state where his existence was centered upon running, running.

Then the Samoan gardener stepped in front of him, and Eduard barely snapped out of his trance in time. The look of concern upon Tanu's face shocked him. He stumbled to a halt, kicking up pea gravel under his running shoes.

Eduard panted too much to say anything, and finally the gardener spoke. "This has gone on too long. I must . . . must show you something."

Eduard drew a deep sigh, astonished. "You've always kept your mouth shut before. What changed your mind?"

"I saw you last night, how sick you were. This isn't right." He swallowed hard, and his sinewy neck seemed barely able to contain his Adam's apple. "It's not what you agreed to do. You have to know what Master Ob is doing. To you."

Eduard felt a jab of fear. "Has he hired somebody already?" He lowered his voice. "I've done everything that bastard—"

"You have done more than you know. You were my friend, Eduard. I don't want to see you go. I don't want to see you die."

"Die? What's going on?"

Tanu gestured for Eduard to accompany him. They crept along the side wing of the mansion, keeping out of view from the windows. They moved to the outside of Ob's private offices. The brick walls were overgrown with thick vines: morning glories and hibiscus, full of sweet, heady perfume. Tanu put a finger to his lips, and they approached the main window in Ob's study.

Thick hibiscus leaves and flowers masked the outside of the glass. Tanu indicated for him to move forward and look. Eduard's heart pounded more heavily than when he exercised hard. His stomach knotted—but he had to know. He slipped over the decorative flowers right up to the window and parted the leaves. Bees flew around his head but he paid no attention to them.

Inside the private office, behind a locked door, the Bureau Chief sat at his desk, complacent about security precautions. In Eduard's body, he leaned back with his eyes glazed and milky. His hands were spread out, tapping with fine tremors on the desktop. A thin line of spittle ran down his chin.

In an open case, Eduard saw the individual vials of a milky substance. . . .

"You son of a bitch," he said under his breath. The pieces dropped into place like broken glass shards falling from above. He wanted to smash through the window to grab the man by the collar. Ob had known full well what was wrong with Eduard, why he felt so awful all the time. But he had lied.

Sandor and Janine and Benjamin—the previous trainers. Eduard was next in line, to be used up by the man's raging addiction. Ob's new trainer, his new victim, would start in a few days—a fresh body to destroy. And Eduard would probably vanish, just like the others.

He backed from the window, his face red, his head pounding. Ob had been *using him*, and Eduard had been the perfect patsy. Trembling, he stepped away from the vine-covered glass.

Tanu frowned, frightened and sad. "There's still time for you to get away. Run. Swap bodies with someone, do it again and again until you're lost—or he'll find you."

But Eduard couldn't think of running off in Mordecai Ob's body. With all the resources of the Bureau of Tracing and Locations, the man would stop at nothing to get his body back before Eduard could talk.

Disturbed, Tanu shook his shaggy head. "I won't help you, Eduard."

Eduard walked with the burly gardener down the path, brooding in silence.

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Finally he said, "I'll take care of this problem myself. In my own way."

XVI

Knowing he could not turn back, Eduard lay awake at night, his nostrils flared, his blood boiling as he seethed through plan after rejected plan.

He was safe for now, as long as he remained in his own aching body. The Bureau Chief was a coward, and wouldn't risk the slightest damage to his own physique . . . not when he could destroy Eduard's body whenever he wanted.

Finally, when Ob went out at night in his healthy home-body, citing important Bureau business, Eduard dashed barefoot through the corridors of the mansion until he reached the locked door of the private study.

The hall lights stood out like glaring eyes, and the rooms were filled with shadows. Ob had been a feared leader of the powerful BTL for too long, and here in his own sanctum the man had become lax with security. The door was locked by a simple deadbolt; with a few minor tools and a tiny magnetic device, Eduard was able to let himself into the office.

The study door creaked open like the gateway to a haunted house. Inside, Eduard found other secrets and plans. Neatly stacked on a corner of the desk were papers, pictures, a portfolio of someone named Candace Chu, who was scheduled to report for work in three days. Eduard stared at the face in the image. This would be his replacement.

A red haze filled his vision, anger great enough to drive off the marrow-deep aches. Once he got away from here, once Ob stopped poisoning his body, Eduard wondered if he'd recuperate, or if the damage was already too deep, beyond repair.

A quick search revealed only one locked desk drawer; Eduard fiddled with the cheap metal tongue, popping it down to uncover Ob's drug stash, which wasn't even well hidden. The man was so arrogant! Apparently, a BTL Chief didn't fear anything the way normal people did.

Eduard removed the sealed box. His hands were trembling, both from his damaged nerves and also with anticipation. He popped open the case and inside, nestled in folds of velvet, were four fragile vials holding a whitish pearlescent fluid. Eduard held one tube up to the light, and his skin crawled.

He removed all of the ampoules, pocketing them, then clicked the box shut to hide his theft. It wasn't a skilled job, but Ob would suspect nothing. *Yet.* Any man with such clumsy locks couldn't be paranoid about anyone stealing his drug stash.

He wouldn't have to fool the Bureau Chief for long.

Eduard returned the empty box to the drawer and reset the locks, restoring the office to the way it had been. As he dimmed the lights and turned toward the door, he glanced a final time at the image of Candace Chu. An optimistic young woman, convinced she had landed a miracle job. Yeah, right. He remembered that feeling.

Eduard smiled wryly at her narrow face, her bright eyes, and her anticipatory smile. "You'll thank me for this, if you ever learn the truth."

Then he closed the office door behind him, running back to his rooms, where he locked himself in. He lay awake for hours staring at the ceiling and the shadows in the corners, anticipating and dreading what he intended to do the next day. . . .

The boundary between friendship and duty was a blurred line for Daragon.

He sat in his computer center at the undersea Headquarters, not seeing his caseload summaries. He had become a prominent Inspector, the well-known pet of Mordecai Ob. Daragon didn't want to do anything that might jeopardize his future with the BTL.

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With his ability to *see* the identity of a fugitive, he'd become an extremely valuable Inspector, perhaps one of the most crucial employees in the Bureau. He had received accolades and commendations . . . but Daragon's most coveted reward was just to continue doing his job and doing it well. And having his mentor, Bureau Chief Ob, proud of him.

Still, it deeply bothered him that Eduard had turned out so irresponsible. Daragon felt as if he himself was to blame. He had thought Eduard would be perfect for the position—obviously he'd been wrong. Daragon worked so hard on his tasks that he couldn't imagine why Eduard would slack off. What more did he want?

But Eduard had always been willing to bend the rules, to take shortcuts, create opportunities for himself. Because of their friendship, Daragon had discounted those personality flaws. He had been blind, and now he'd have to pay the price.

Daragon left the computer room, marching to the BTL transport depot. Eduard had let him down, but he hoped he could talk to his friend, work out some sort of compromise to salvage the situation. He suspected it was already too late. Ob's new personal trainer would start soon. But he had to try. Daragon would take this one last chance for his friend, no matter what Eduard had done in the past.

Setting his jaw, he flew away from the ocean platform, setting a course for the Bureau Chief's estate.

Next morning, meek and subservient, Eduard came to meet his employer with lowered eyes. He stood ready to hopscotch for the last time. *The last time*. Ob touched Eduard's temples, and the two of them swapped. The Bureau Chief scowled at his trainer's body in disgust. "I can't tolerate this any longer, Eduard."

With great difficulty, Eduard held his anger in check. How dare Ob complain about such things, when it was his own addiction that had caused the debilitation? He drew a deep breath, feeling refreshed and vibrant. *This* body moved the way it was supposed to, without pain—too bad it wasn't his own. He looked through a stranger's eyes, seeing the weariness and the jitters, the sallow skin, sunken eyes of his home-body.

Ob said, "I have a meeting this morning, but I need to see you briefly after lunch. We'll swap back and then . . . then we have to talk."

Eduard nodded. "Yes, sir. I understand."

Ob paid no attention to him after that. The Bureau Chief had never treated Eduard as more than a worker, someone who exercised his muscles, maintained his beloved body in perfect workable shape. A disposable human being. . .

Halfway through his exercise routine, Eduard came to a sudden stop and asked himself why he was spending so much time and effort. "It doesn't matter a bit, not any more." Then he began to laugh at the idea.

Eduard took a petty pleasure in stumbling sideways, brushing against a hedge and scratching himself along the legs and arms. *My, wouldn't that upset Master Ob*? He decided to go to his rooms and just enjoy the pleasant sensations of a healthy prime-condition body for a change.

Tanu, always silent, always watching, looked up as he saw Eduard striding back to his apartment long before the exercise routine should have finished. The gardener frowned, then went back to tending his rose bushes.

Eduard watched the clock as the hours slowly passed. He took a luxurious shower and stretched out on his bed. His mind was tired, but the body felt well-rested. Ob, no doubt, had slept well, a peaceful slumber without worries. Why should he be concerned? Eduard's body was paying for his sins.

When it was time, all of Eduard's nervousness and anticipation turned to cold iron inside of him. He had made up his

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mind.

Wearing Ob's body, he stood outside the door to the Chief's private study, where the man waited for him. He hesitated and took a deep breath. In the palm of his hand he held the last four stolen vials of the pearlescent drug. Deftly he slid the small cylinders one at a time into his mouth, tucking them on both sides of his tongue and up behind his teeth. He hoped he didn't look like a chipmunk. He would have to keep his head down. Luckily, Ob wasn't much of a conversationalist.

He knocked on the heavy door, and when Ob told him to enter, Eduard strode forward, breathing through his nose, keeping his lips clamped shut, his gaze averted. He just wanted to swap back out of this doomed body.

From behind his desk, the sickly-looking form of Eduard stood up. "You're late. I expected you ten minutes ago. I've got things to do."

Eduard grunted noncommittally and came closer.

Then Ob hesitated, thinking of something. Eduard could feel the fragile dissolving gel in his mouth. He couldn't swallow, couldn't move. He didn't even know how quickly the drug would act.

Ob pointed a finger at him. "We have business to discuss, Eduard. It's about your employment with me, and your performance on my behalf."

Why was Ob talking *now?* Why didn't he swap first and then continue with his lecture? Eduard just nodded, blinking his eyes dully. Ob considered him little more than livestock anyway. He wouldn't expect an intelligent reply.

As Ob came toward him, he stopped again, hesitating in extreme annoyance as he noticed the rosebush scratches on Eduard's arm and the side of his leg. "You've done it again! This is inexcusable. Your employment is terminated!"

Eduard reached forward and grabbed Ob's temples, and the man responded automatically. "Yes indeed. I can't stand being in this form any more."

Eduard bit down, shattering all four vials in his mouth.

The instant before he swapped, he felt a cold, awful-tasting fire surge through the sensitive tissues in his gums, under his tongue, and through the roof of his mouth. Now he knew the source of the horrible taste he'd lived with for so many months. He felt a lightning-storm begin to surge through his mind, through his nerves—

Then his mind was displaced, flicked across the gulf . . . and he found himself in his own aching body again. Back home.

The look of wide-eyed horror on Ob's face was comical. He grabbed his throat, swallowed convulsively, then opened his mouth and spat out the chunks of already dissolving gel.

Eduard burst out in hysterical laughter. "Surprise!"

Ob blinked his eyes, but already his vision glazed.

Eduard narrowed his eyes, ferocious now. "How do you like the taste, Master Ob? It's your own body this time. And I gave you four vials of that drug. Enjoy the sensation."

"Four!" Ob gasped, his voice strangled. "Rush-X . . . four!"

During his growing addiction, Eduard's body had developed a tolerance, but Ob's perfectly tended body was clean. It had no resistance. One vial would probably have been more Rush-X than he could handle.

And now four were coursing through his system.

Ob staggered forward, stretching out his hands. "Swap back!"

But Eduard easily stepped away from the disoriented man. "Yeah, right. You've caused me enough problems. See what you've been doing to me all along?" He leaned forward like a vulture. "Did all your trainers die, Master Ob, or did you simply discard them before it was too late?"

Ob slumped to the carpeted floor, his fingers clenched in a clawlike grasp.

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Then his face grew slack, subsiding into an idiot grin. His eyes became metallic, and drool poured out of the sides of his mouth. He coughed and shuddered and twitched.

Eduard had never been so glad to be back in his own body, despite its flaws, despite its weaknesses and its degenerating condition. But it was *his* body. He stood over Ob as he degenerated into a quivering mass on the rug. The Bureau Chief's crotch darkened as he lost bladder control.

Eduard wondered with brief remorse if he could possibly call a medical team. Maybe they would be able to revive him. But that wouldn't make anything better. By now Ob would be severely brain-damaged, a vegetable.

Eduard took another step away, wearing a self-satisfied smile as he watched Mordecai Ob die. . . .

Then the anger washed out of him like cold water draining from a basin. He'd gotten his revenge, poetic justice against the man who had addicted his body to Rush-X. Ob had chewed up one trainer after another with his need for thrills.

But Eduard had just murdered him.

He suddenly became paralyzed as he realized what he had done. Perhaps he could claim that it was some odd form of self-defense—but he had killed the Chief of the Bureau of Tracing and Locations, a vastly powerful man. His fellow Beetles would never rest until they captured Eduard. And, no matter what excuses he tried to make, Eduard knew he had committed murder. There was no other word for it.

Eduard had been impulsive before, and done ill-advised things, but he had *planned* this. He had spent a day setting it up. It was premeditated.

He looked around, trying to decide what to do. He had to get away, take Tanu's advice, swap from one body to another to another, on the run. He would move on, begin a different, desperate phase of his life.

He turned, leaving the still-twitching corpse on the floor—then he heard footsteps in the hall after a door closed. An identity chime rang through the intercom system. "It's Daragon, Mr. Ob. I'm here for our appointment . . . and I'd also like to see Eduard, if that's all right."

Boots clomped on the floor, and Eduard heard him coming toward the study. Daragon, his former friend, who was now totally devoted to the BTL. Especially to Mordecai Ob. He would never listen to what Eduard had to say.

As Daragon came down the corridor, unsuspecting, Eduard knew he was trapped. But perhaps he had just enough time. . . .

He picked up the desk chair and hurled it through the window masked by hibiscus vines. The glass shattered, and the chair hung up on the green tendrils. But it was enough for Eduard to scramble through.

Hearing the glass break, Daragon ran. "Mr. Ob!"

As Eduard climbed to the windowsill, pushing himself through the vines, Daragon burst into the office. From across the room, his dark eyes met Eduard's fearful gaze.

Eduard froze. "I'm sorry, Daragon." Then he dropped to ground level. He would never have a chance to explain more. He would never see his friend again—if he could survive the next few minutes.

Daragon noticed his mentor sprawled on the floor. "Mr. Ob! My God!" He fell to his knees, grabbed the man by his shoulders, touched his cheeks. He saw the drool and the drugs, felt the oily-slick perspiration covering the man's already cold skin. He felt for a pulse but found none.

"Eduard, come back!" He sprang to his feet and ran to the broken window, ripping vines aside. Eduard sprinted across the estate grounds toward the gated exit.

Hearing the shouts, the huge Samoan gardener hurried toward the office from the outside.

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Daragon crawled through the smashed window, tearing his neat, dark uniform. He jerked vines away from his face, scrambling through, dropping to the ground—and Tanu stood there, stopping him.

"What is it?" the gardener said in a deep voice. "What's happened?"

Daragon looked after Eduard. "Not now!"

But Tanu grabbed his arm, clumsily trying to stall the Inspector. "Tell me! I should know."

Daragon yanked himself free. The big gardener moved as if to stall him again, but Daragon ducked under his massive arm and ran. "Damn you, Eduard!" His former friend dashed through the gate and out into the streets, where the bustle swallowed him.

Behind him, Tanu shoved his broad, tanned shoulders into the broken window frame. Inside the room, he saw Mordecai Ob sprawled on the floor, and he knew exactly what had happened. He hung his head, staring sadly.

Far behind now, Daragon shouted in pursuit. But Eduard had always been good at running.

Now Eduard would use the skills he had learned over the years, trade his body for another, and another. He would flee from person to person, never keeping one particular face for long. Away from the estate grounds and into the city, he had all of humanity in which to hide, as long as he could stay one step ahead of his friend.

Not exactly the next phase he had planned for his life, Eduard thought, but he would cope, somehow. Eduard was a survivor. ▣

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Neuroscience and Other Intelligences

Thomas Donaldson

Over the past 15 years (the "Decade of the Brain") neuroscientists have made several significant new discoveries about how our brains work. A full discussion of each one would take up an entire article; I shall begin by here discussing each one briefly, with an eye to what it means—and in particular what it means about the possible form of other intelligences that might exist—rather than the exact details of how it works. The boxes contain a bit of further discussion together with some references for those who want to learn more.

The Formation of New Memories

LTP (*Long Term Potentiation*) and LTD (*Long Term Depression*) have become famous, but the complete formation of memory involves other, later, reactions. Our synapses grow larger. Although it does not always happen, one other significant event in memory consists of growth of *new* synapses (see Fig. 1; Box 1 gives further discussion). Growth or increase in the number of synapses provides one way by which memories last longer than any simple chemical change at a synapse.

Although many neuroscientists still study only our hippocampus (a special region in our lower brain involved in formation of *some* but not all memories), when we form a memory its final storage usually occurs in several different places, depending on its subject. The same occurs when we form other memories not involving our hippocampus. The last 15 years of work on how brains work also produced one major insight into memories: that we have at least three different kinds of memory, each

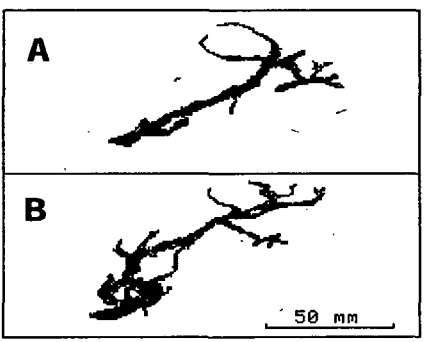

Figure 1: New Synapses in Neurons
A and B show the same neuron but B is one month later. The neuron is in a sypathetic ganglion. Its change in branching also means that its *synapses* will also have changed. This kind of change apparently occurs in neurons of our neocortex also, but is much harder to catch in a simple picture. From D. Purves, R.D. Hadley, Nature 315 (1985) 404ff.

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one created by different brain areas. Box 2, p. 42 gives a synopsis of the different kinds, to which I give particular names: *Events, Facts,* and *Temporary*. Note that each of these gives a *general class* of memories, and Facts and Events split up even further into particular subjects and relations. We may in future find that the other kind, Temporary, does the same.

How Our Brain Works

The best present ideas for how our brain works suggest that, first, our brain largely consists of one or more very large neural nets, with some extra circuits to a general consciousness. The neural nets forming our brain differ fundamentally from computer neural nets because formation of memories can involve *formation of new synapses* connecting different neurons. While single computers can imitate small neural nets, a large one requires a special kind of parallel computer. This gives one more insight into how our brains work: our neurons form part of one or more large parallel computers. Because of that parallelism, the speed of individual neurons becomes much less relevant than the speed of the entire brain. Furthermore, some (or even *all*) circuits contained in this parallel computer may require one processor to deal with one particular class of events . . . which may make it difficult to simply substitute fewer but faster processors for individual neurons. Our visual system gives an instance of this.

As for the aim of making a computer which truly imitates a human brain, it's the growth of new synapses which makes doing so harder than most computer people now anticipate (cf. Box 1). Moreover, our neurons also lose synapses, too. Our brain's neural nets aren't really imitated even by current parallel computer neural nets. The second feature, of neurons dealing only with particular classes of events, adds to the difficulty.[1] (This isn't just my opinion. Cf. also comments of Cristof Koch, *Nature* 385(1997) 207-210. I see the problem as much harder than most may think, but not impossible).

Box 1: Some References on Change and Growth Synapses

WT. Greenough, TRENDS IN NEUROSCIENCE 7 (1984) 225-233
A review on the subject of growth and change in synapses

M Wilson-Hotch et al NEURON 23 (1999)353-363
Dendritic spines (which carry most synapses) grow and disappear constantly

F Engert, J Bonhoeffer NATURE 399 (1999)66-77
Growth of new synapses after stimulating the hippocampus.

MG Stewart, FG Patel BRAIN RESEARCH 4639 (1987)160-173
Changes in number and structure of dendritic spines

Consciousness

In the last five years, neuroscientists have also studied consciousness, though their understanding of how consciousness might work remains more primitive than their understanding of memory. Some experiments have also shown that we can begin to react to an event *before* we become explicitly conscious of it. Given that our brain consists of many neurons working in parallel, how we have a *sequential* consciousness becomes a quite pertinent question. Even though we can change our attention constantly, we remain unable to attend to many simultaneous events.

The extra circuits giving consciousness must work to bring some part of our brain's activity *into* consciousness. While some neuroscientists suggest that we have no central region, the question of just why we would become conscious of one series of events and ignore

[1] I do not claim here that this is impossible at all; I'm merely pointing out that brains work in a different way than current computers. If we find that to imitate a brain we need components with features quite different from those of computers, this would still not make construction of a brain impossible. It would simply raise questions as to whether the result was a computer.

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Box 2: Different Kinds of Memory
Our Memory falls broadly into 3 different kinds.

TEMPORARY
Often called "Working Memory." Areas responsible lie in our frontal cortex. Tested by the ability to remember a sequence of numbers for a short time. We extend its capacity by remembering abstractions, but it takes in at most 8 things.

EVENTS
Memory for particular events that happened to oneself or others: moments of your childhood, who won the recent election for governor of your state. Historical events happening while we're alive also are included. Our hippocampus plays a major role in such memories.

FACTS
This is the kind of memory which recalls things about the world without any memory of how and when you got that knowledge. For example, someone whose hippocampus has been destroyed can still remember their name and do calculus if they could do calculus before.

Events and Facts break apart into many different kinds, stored widely within our brain. Its locations correspond broadly to the senses involved in that memory.

another remains unanswered . . . unless we suppose that some area in our lower brain plays a major part. (Our *thalamus* contains a major candidate.) Since it is our *lower* brain, rather than our cortex, that produces our desires and feelings, it's appropriate to look there for the areas which choose such events. This does *not* mean that we might have one special neuron which implements our consciousness. At the same time, we know that our consciousness of different features of the world depends very much on our desires. And our desires guide that consciousness in basic ways.

It's also quite interesting that so far *no* thalamic area receives input from *all* brain regions. Recently some neuroscientists have found evidence that just like other mammals, we not only respond to special odors, but remain unconscious of them. The region making such response in animals is called the *vomeronasal* region. Our perception of odors, generally, isn't as well connected to the rest of our brain as the other senses. Just what this may mean for our consciousness remains an open question.

The main role of our consciousness may be to provide an overall guide to our activities. To do so, it need not even be conscious of most of our brain's activities, but it must be aware of our desires and goals, and in a nonspecific, broad way, of our situation and current perceptions. The choice involved would be important; our desires and goals don't seem to just compete among one another.

What might these insights tell us?

I've described here the way our brains work, very like those of all other mammals. The anatomy for brains of birds and reptiles differs, but the basic principles (and by implication, the way they work) look very similar. One good reason to believe that comes simply from the way evolution is conservative. Bird and reptile brains use the same transmitter chemicals, and their neurons work very much like our neurons. Over the whole range of earthly life, from plants to microbes living in hot water to mammals, we're actually quite close to both birds and reptiles, and fundamentally not far from that of insects, fish, or crabs.

However as "brains" we also now have computers, which work quite differently. Not only that, but it's an open question whether or not any brain, even for a living creature, *must* work just like ours. If we suppose that brains can work very differently, then we have no reason to believe that other intelligent species are even conscious or have the same kinds of memories we have. Just what is an "intelligent species"? For this article, I shall suppose that intelligence requires the ability to make some kind of technology as elaborate (or more) as our own. I shall discuss some possibilities in the remainder of this article.

First, computers

I'll begin by considering computers which weren't built with any attempt to imitate how our own brains work. The very first point comes from the origin of

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Box 3: Where and How Does Our Consciousness Work?

J Pollock, HOW TO BUILD A PERSON: A PROLEGOMENON, MIT Press,1989
Pollock presents ideas for building a robot "human being." Very interesting for its connection of goals and desires with consciousness. Several points it makes remain valid, though we now know a lot more about the nervous system than we did in 1989.

DE Dennett, CONSCIOUSNESS EXPLAINED, Little, Brown, and Co, 1991
Dennett argues against the notion that there is any single spot in our brain through which everything of which we are conscious passes. The origin of this point comes from experiments showing that we can easily become conscious of something only some time after our eyes registered it.

Neuroscientists started studying consciousness again quite recently, so its understanding remains more fragmentary.

JE Bogen CONSCIOUSNESS AND COGNITION 4 (1955) 52-62; 137-158
Bogen argues that one part of our thalamus, the interlaminate nuclei, play a big role in consciousness.

Some papers other than Bogen's on consciousness, with related but hardly identical ideas:

F Crick, C Koch NATURE 375 (1995) 121-123
Fuzzier than Bogen, but agreeing with him in some central ideas.

J Newman Consciousness and Cognition 4 (1995) 172-193
In the same issue as Bogen's first article.

M Cabanac NEUROSCIENCE AND BIOBEHAVIORAL REVIEWS 20(1)(1996) 33-48
JA Gray BEHAVIORAL AND BRAIN SCIENCES 18(1995) 659-722

the word "computer": computers started out as human beings whose job was to compute; though we do have some ability to compute, even people focused on nothing else clearly cannot match the computational abilities of computers. If nothing else, this suggests that our brains evolved much more as general databases than to compute (the comparison is that between using LISP to do computations versus FORTRAN). And if we're interested in abilities to do things which need intelligence, computers from their very start had one such ability to a much higher degree than we did: ability to do computations. Proof that the computer Big Blue could win games with chess champion Gary Kasparov really didn't add to that ability. This also shows us a major point we should not forget: even some earthly animals may have some intellectual abilities greater than our own.

Many devotees of computers also forget a second point: our brains are highly parallel, while most computers remain quite sequential. If we aim simply to solve an intellectual problem, that difference means little.[2] However, any creature living in the real world must deal with many events, all happening at the same time. Evolution has built parallel computing into our brains; any creature, computer or not, which operates only sequentially, or even in parallel, but not with *enough* parallelism, simply fails. This parallelism means that comparing the speed of a single neuron with that of the fastest computer processor completely misses an important point about nervous systems.

Vision provides a very good example: each receptor for light in our eyes acts in parallel with the others. After that, other parallel circuits, each working on only one part of the view our eyes see, processes them into more elaborate images. When we consciously see, we nev-

[2] Turing's ideas dealt only with a sequential computer, and totally ignored the speed of computations. I suspect this came from the simple fact that Turing only considered computers as knowing or thinking rather than acting. Even if we admit the value of Turning's ideas for that case, the need for parallelism means that our brains, and even ANY computer built to act in the real world, in which many things happen simultaneously, involve an issue of TIMING which Turing never considered.

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er see the original light input. Instead, we usually see well-defined shapes and colors to which we can put names. The same kind of parallel processing occurs for all our senses. It's even likely that our brain processing has evolved to be fast enough for our style of life (which does not mean it will always be fast enough—a different issue).

Finally, could we ever build computers capable of all the kinds of activities we humans do, and better than us? Right now, no matter how powerful, our computers are tools only. To make a device (including a computer) not only superior to us but also able to act independently from us, we need also to give that device its own wishes, goals, and desires. Without these, no matter how intellectually superior we make our computers (or other devices) they remain only tools.

Giving a device its own wishes, goals, and desires may be harder than many think, but clearly it isn't impossible. I will add, though, that doing so hardly seems very wise. We may someday build less powerful devices, even those lacking some important ability, simply to study how we work. We have no more reason to build a device superior to ourselves than we do to commit suicide in less elaborate ways.

Yet one more question still remains: could *animals* that had abilities similar to those of computers evolve naturally? Our own abilities do involve some specialized ability to compute such things as trajectories of thrown objects. Animals with general computing ability would have to evolve in settings in which computations of many different kinds had to be done constantly, for survival. If we ever find animals and plants living in asteroid belts rather than on planetary surfaces, they might have just such abilities. Jupiter-sized planets close to their suns already exist, and they might have Earth-sized moons. Perhaps the notion of a habitable asteroid belt surrounded by gas isn't as outrageous as many might think. Moreover, even a race of human beings who colonized asteroids might need much-extended abilities at computation, and so modify themselves to have that feature.

Is consciousness necessary for intelligence?

Consciousness doesn't obviously tell us anything at all about goals. Even *paramecia* act as if they have goals (and may be considered to have them), though no one argues that paramecia are conscious. We've also seen that consciousness may have some special value to us, with the way our brains work. It's part of how we choose to look at one thing in a scene and ignore another. (A few neuroscientists argue that consciousness is useless, but the simple fact that we are conscious then becomes no more than a useless feature. This idea, however, runs into a fundamental problem: natural selection tends to eliminate useless features.) Box 3, p.43 gives some references to ideas about consciousness.

However, if we consider how other intelligent creatures may have evolved separately from us, another feature of

Box 4: Stem Cells Making New Neurons in Adult Brains

Our brains too grow new neurons, even as adults. Neuroscientists have known this for several years now, though it is contrary to what many believed for a long time. Some recent references:

E. Gould et al SCIENCE 286 (1999) 548-52
A recent paper finding generation of new neurons in many areas of the neocortex in adult *macaques*. We are likely to have the same trait.

SA Goldman, JOURNAL OF NEUROBIOLOGY 36 (1998) 267-286
Paper finds widespread neural stem cells in the *temporal cortex* of HUMANS.

J Frises CELL 6 (1999) 25-34
Our ventricles are open areas filled with fluid in the midst of our brain. They are lined with a membrane, the ependymal membrane. Frises reports finding neural stem cells in this membrane.

RDG McKay, O Brustle CURRENT OPINION IN NEUROBIOLOGY 6 (1996) 688 ff

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evolution becomes important, too. Even if consciousness somehow makes us superior to paramecia, it must first *evolve*. The total range of possibilities for evolution has hardly been covered by Earth life; we can imagine forms of life evolving on a planet in which consciousness in our sense never arose. How far could such creatures go?

1) Consider ants, which have produced several features we associate with intelligence even on Earth. Some species farm plants, others have domesticated other insects. Some take over nests of other species of ant, making slaves of them.

One major point to remember here is that the required evolution may easily take millions of years longer than our own: but the length of time needed does not prevent it from happening. Imagine insectlike creatures which combine all these abilities in one species, and then go on from there. In a sense they would not even use tools in our sense; instead, a set of ants would combine to do a job. If such creatures continue to evolve, they may well develop even more: nests with artificial environments letting them prosper where previous similar creatures could not, and even a kind of invention of flight which did not just disperse one creature but a collection of them.

(Even on Earth, male ants have wings to help them disperse. Suppose our antlike creatures instead made small nests which could act as balloons, to disperse a small but working nest genetically related to its parent.)

Could such creatures go so far as to develop spaceflight?

Several scenarios might allow that. Suppose that instead of a totally Earthlike planet, they evolved as life forms on a planet with a highly elliptical orbit, that only sometimes had earthlike conditions. This would then promote evolution in which they could actually survive and act in conditions similar to those on the Moon, but much colder (making their own heat). Once that had happened, they might even go on to develop rocketlike propulsion so that they could not only live in spacelike conditions but disperse themselves in such conditions, too. Other conditions might promote this, too. Even the development of balloonlike flight might ultimately put the problem of living in spacelike conditions; if these creatures evolve to do that, then they may go even further.

And note that they're doing something quite different from space travel in our sense: the length of time for transport becomes unimportant. It's dispersion of your *kind* that you want, not yourself.

Yet none of these changes would involve consciousness at all: the individual creatures would need no more intelligence than an individual ant (though they may develop many more castes than Earthly ants). Each such nest would also consist of closely related creatures, with no interest in communicating with other nests. Nor would such creatures ever be conscious in our sense.

2) *Must* single brains evolve consciousness? Here is a different kind of example. First of all, even in the growth of our own brains when we're embryos, individual neurons compete for connections. Those that never attain enough connections simply die. Our consciousness provides one means by which we choose our actions; suppose instead that such choices involved similar competition between neurons to that we had as embryos.

Such a creature might easily have much intelligence, but its brain anatomy and the behavior of its neurons would differ sharply from our own. Competition involves elimination; such a creature's brain might therefore have many neurons which come into existence only temporarily. This may mean that cells capable of growing into neurons occured far more widely in their brains than in ours; it also raises the possibility

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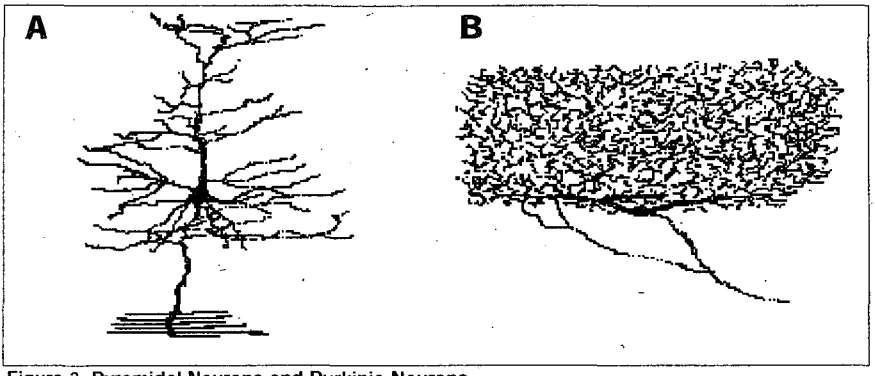

Figure 2: Pyramidal Neurons and Purkinje Neurons
A is the pyramidal neuron, B the Purkinje neuron. Pyramidal neurons dominate in our neocortex, Purkinje neurons our cerebellum. From Ramon y Cajal, *Histologie des Systeme Nerveux . . .* , Madrid, 1955.

that some of their "neurons," quite unlike ours, actually and frequently divide (division does not require that one neuron produce another with the same connections, it would just bud off another neuron). Growth of connections could happen afterwards. (Though we would not grow new neurons nearly as much as these creatures, we still grow new neurons, though we use a different system. Cf. Box 4, p.44)

And most importantly, our consciousness works to make the kind of broad choices that, in creatures of this kind, would be done by competition between neurons. They would be intelligent but have no consciousness at all in our sense.

Communication between such creatures and ourselves would likely prove difficult or even impossible. At the same time, both trade and conflict could happen, each done directly: we put out something the other creatures might want, and train them to give us something in return. On our side we'd need lots of understanding of how the other side worked. The other side might well not even react to us unless we put ourselves in their way, positively or negatively.

Different ways of thinking

Our brains also have a particular organization. In very broad terms, we have a *neocortex* enfolding our lower brain (which deals with such important things as drives and feelings, and contains our *hypothalamus*, our *thalamus*, and other important areas), a *cerebellum* which mostly deals with physical movements, and a *spinal cord* which takes input from touch, pain, and pressure sensors in our body and outputs commands to our muscles. Our intelligence comes from the abilities of our neocortex, in remembering, combining, and understanding the input from our senses and our history. It's of interest that even birds have different brain structures, but with very similar neurons and activity.

We might imagine, then, a creature with a comparatively small brain neocortex, but a far more elaborate and extensive cerebellum. The main cells in our neocortex are *pyramidal neurons* while those in our cerebellum are *Purkinje neurons* and smaller *granule neurons* (Fig. 2). (I do not know of any source explaining their different structures.) Our cerebellum mainly deals with complex movements; however one important, recently discovered fact is that our cerebellum plays a role even in thinking which doesn't deal with movement in any obvious way (E. Courchesne et. al. *Science* 375 (1997) 1940ff). A speculation: creatures with brains dominated by the cerebellum

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Box 5: The Many Different Senses Known

Some senses known in Earthly animals:

CHEMICAL	LIGHT	VIBRATIONS
odor	light	noise
taste	electrical fields	vibrations
	magnetism	
	heat	

I exclude here any senses by which an animal senses its inner state, such as *hunger*. In the case of vision, rhodopsin (and its chemical relatives) provide a chemical with very fast reaction times. Again, many fish have a sensor land animals totally lack, The *LATERAL LINE*, which runs on both sides of their body. Depending on species, it senses vibration, pressure, temperature, salinity, or electrical fields. *This tells us that senses need not consist only of small sensitive areas, but might have many different arrangements on their animal's body.*

For eyes, we know two kinds:

COMPOUND EYES
sensitive at any distance
can see UV light
sensitivity to polarization

REFRACTING EYES
can focus on nearby objects
some loss of light
insensitive to polarization

For sound, all Earthly animals depend on a special kind of cell, *hair cells*. Sensitivity might be organized differently: an animal might use an organ running along its entire body for low sounds, and like bats have complex ears for sensitivity to high frequency sounds.

rather than the cortex might well have many more connections between events. (Fig. 2 shows how Purkinje cells have many dendrites, each connecting with different granule cells.) Such a brain might also find it impossible to think of anything separate from some activity it acts on. Our own physical or chemical theories try to tell what is *true*, not the many different combinations of activity objects might have.

Again, could the very basis of memory work differently? We absorb memories in at least two stages (some theorists suggest many more; *LTP* and *LTD* are the earliest). Suppose creatures that had more stages, but rather than using our process of attention, they instead acquired some memories without going through one or more of those stages. Their view of time would seem much more like any other dimension, as they became aware of "simultaneous" events at different times (in *our* judgement). Unlike us, their view of the past would look just like any other spatial dimension, except that much of it would be always cloudy so they could not see it completely. Such creatures would at least start their physics in a way we would not, and so even discover physics in a very different order from our own . . . including physics we may not yet have discovered ourselves (and we may relate the same way to them).

The many senses and how they might combine

Different senses give us a third way in which creatures evolving separately from us might differ profoundly from any Earthly life. To work out some possibilities, look at Box 5, in which I have listed all the known senses for Earth animals. In a very rough way, they fall into groups: chemical senses (taste and smell), visual senses (light, magnetism, electrical fields, and heat), and sound (noise and vibrations). I exclude here internal senses such as balance or the senses which make us feel hungry. These may make it hard for us to understand the actions of some other species, but may not affect how they deal with the world (or with us!).

Because of our evolutionary history we see each of the senses in a category as different. However, other creatures with very different histories might well combine some of these. For instance, they might have highly evolved and active chemical senses which don't easily separate into odor and taste. (Some Earthly animals, such as cats, have special structures allowing them to taste chemicals they smell. But smell and taste could be far more integrated than this.) Again, we see light as separate from electrical fields or heat. Even if such creatures look to us as if they have separate sensors, *the important difference*

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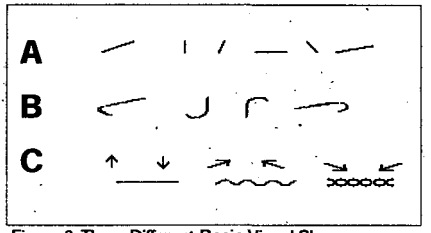

Figure 3: Three Different Basic Visual Shapes (Ours and Two Others)
A shows some of our own basic shapes: lines of various directions. B shows a set of possible basic shapes: *curved* lines with directions. Finally C shows a more complex set: the arrows give directions, which are independent of shape. The diagram of C shows two different sets: first in directions, in this case independent of the particular object. The second row gives some basic objects which take the various directions given at the top. Even if eyes are the same, brains can interpret sight differently.

comes from how their brains combine the input from their sensors, not from the sensors themselves.

These possibilities go even further: we, too, combine inputs from different sensors. Our brain doesn't distinguish between inputs from two kinds of visual sensors, for instance. The rods in our eye distinguish level of light and forms of what we see; the cones measure colors. We see a unified vision of a scene, while some other creature which separated these sensors might think them just as separate as we think heat and light are separate.

Moreover, different Earth animals have two quite different methods of seeing: eyes with *retina and lens* like those we have, and *compound eyes* like those of insects and some other invertebrates. Compound eyes have features lensed eyes don't. A creature evolved elsewhere might well have both kinds of eye, and either combine their inputs to understand a scene or perhaps separate them into two different senses. Vision has many different brain levels, too. Our brain has circuits to distinguish straight lines and their direction; other brains evolving separately might have circuits which distinguish different forms of curved lines (cf. Fig. 3), or even see a line not as a single entity but composed of a line, a direction, and a length (each perceived separately). How we perceive the world affects fundamentally how we later learn about it.

Specifically because as human beings we're much more sensitive to light while our chemical senses are comparatively weak, here's one possible creature with almost the reverse of our senses: highly evolved chemical senses, not just for taste and smell but possibly several separate organs depending on the chemistry involved (and perhaps too, nothing which easily correlates with our sense of taste). Its brain would interpret chemical input in much more complex ways than we do, with some sense of position, and many more "odor colors" than we see light colors. Many Earthly animals use odors to communicate; we can imagine that an intelligent creature of this kind might even evolve a communication system as complex as our own, but based entirely on the emission and sensing of odors. It is only our poor ability to detect many different odors that make such a language seem impossible.

It would also look quite different: perhaps with a few small and weak eyes, and chemical sensors all over its head (organized so that they draw in air). The system for bringing air close to its sensors need not even coincide with any system it might have for respiration; and if it communicates with odors, the glands producing these odors would also come with means to expel their output. (Such a system might evolve in creatures which began as animals living in water, but they need not remain underwater.) Such sensitivity to chemistry might well also make such creatures advance much faster than we in studying chemistry, while remaining comparatively primitive in understanding light.

And it's precisely because our senses would differ so much from the senses of such creatures that even understanding that it had a language and intelligence might prove very hard for us (and also for them). As visual creatures, we write by

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means which are visually obvious; an intelligent creature using chemical senses might still have writing, but with invisible chemicals whose odors we could not naturally distinguish. It may even use diagrams, but again of chemistries we don't naturally sense. With their highly developed chemical senses, they might also understand chemistry much earlier than us; and chemistry leads (over time) naturally into study of atoms and their nuclei.

Could such creatures develop space travel? Without our emphasis on vision, they would not notice stars or planets. Over much longer times they might notice meteorites, and work out that they fell from the sky. Such discoveries might then cause them to develop *visual machines*, just as we've begun to develop machines sensitive to odors. From there they might eventually understand how they lived in a planetary system and learn of the presence of other stars and galaxies. Given that they must first learn about many things obvious to us, their understanding would come far later in their history. Even the idea of space travel, again, would come much later; but once it happened, their deeper understanding of chemistry might make at least chemical rockets, and perhaps even nuclear rockets, very easy for them.

What neuroscience can tell us

One final but important point: *not one* of the forms of intelligence discussed here would be likely to contact us, *especially* not by radio. Creatures without consciousness, such as the super ants, would probably not even care about other intelligences. Creatures organizing the world very differently from ourselves because their brain(s) had very different structures (such as expanded cerebellum instead of cerebrum), might see the world so differently from us that communication becomes impossible. Even creatures depending on chemical senses, though they might take much longer to even discover the existence of other stars or radio waves, would probably have a language which could not be translated into any form of human language. We talk about what we see; a language only about what is smelled or tasted could not be easily translated into one about what is seen. Even their mathematics might be affected: someone perceiving only smells might not see *anything* as discrete, and so never learn even to count in integers . . . even though they would still have ideas corresponding to our *real numbers*. A message on a space probe which began with counting would be quite mysterious.

I've written here of some ideas and speculations which neuroscience produces when we regard it as hints about other kinds of intelligence. Those other kinds may be built by us, or alternatively evolved on planets able to support life but only life unlike our own. Even now, though we still fail to understand many things about how our brains work, it's clear that the possible life-forms that might develop technology cover a far larger range than those appearing in most science fiction. While physicists watch, biology slowly acquires many fields of bioscience just as exact as any physics. This article only hints at the ways it will make our understanding of possible life-forms far broader and deeper as a consequence. ■

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Heroism takes a wide variety of forms....

NIGHT VOICES

Stephen L. Burns

Solomon Knight topped off his coffee mug and eased back in the swivel chair, trying to settle his ramshackle body into a position that would ease the twinge in his spine. He managed a healthy swig before the canned acknowledgment for Pharm Barn concluded with its trademark *moo,* then toggled the pinmike of his cordless headset back on. While his body might have been prey to DJ's Back, ulcers, and a few other annoying ailments, his voice rolled out sweet, rich, round, and deep as a multilayer chocolate cake.

"Here we are back again on K-L-P-Y Public Radio with *Night Voices,* Solomon Knight, Philosopher-at-Large ready to take your calls." He reached out and tapped the button for line three. "Solomon here. What's on your mind?"

"Solomon? Am I on?" The voice over the headset was youngish and female. He could tell that she was smoking. As usual, that set off a wistful pang of nostalgia for the cigarettes which had once helped keep him company through these long nights. His last wife had made him quit. He'd quit his last wife, but somehow managed to keep from going back to two packs a day. So far.

"You most certainly are. What's your name, and what weighty matter have we to consider?"

"Betty, uh—"

"First name is enough, Betty. Now talk to me."

"Uh, okay. Y'know that UFO thing, right?"

"Yes? What about it?"

Her voice dropped, took on a secretive tone. "I think they're here. Aliens, I mean. And they're taking over people's brains. Y'know, like in that movie."

Sol glanced up. Lori, KLPY's green-haired, nose-ringed night engineer smirked back at him through the studio's glass wall as she wiped a number off a small whiteboard pinned to the wall with the sleeve of her ratty flannel shirt, replacing it with a new one. 132. Betty was the hundred and thirty second caller in the last four days driving a spaceship. His listeners, bless 'em.

"What makes you think that, Betty?"

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He intoned the obvious next question without a single trace of sarcasm. The smartmouth gig had never been his bag. Although he did on occasion permit himself to indulge in a tasty frisson of irony.

"Well, for one reason, I have this friend, y'know?"

And her very best friend, Solomon prompted silently, quoting the genesis of innumerable urban—and suburban, and pure corn country—myths.

"—And her very best friend, y'know, saw it come down."

"No kidding?"

"Really. She said it must've crashed out near Mount Rifkin."

"Well, that happens to be our back yard, Betty. Now there was something damned unusual in my parking space when I came to work, but it was a Saturn with New Jersey plates, not a flying saucer from Saturn."

Betty laughed. "I know you're joshin' me, but I think it's out there somewhere. That's rough ground, and it took a couple days to find that plane that crashed there a few years back."

"I suppose you could be right, but after four days nobody has found any wreckage. According to the news it never showed up on the radar at Fort Coggins. There is an official search, but so far *nada.*"

"That's what they *say.* But what if they've already found it and just aren't telling us? Like with that ship and those aliens they've got stored at that place, you know . . ."

"Area 51?" he supplied dutifully.

"Yeah, there. They've found it, but are, y'know, keeping it a *secret.*"

The same government caught in a pants-down or hand-in-the-till scandal at least once a month, the latest being a noted 'family values' senator caught entertaining oral argument from the floor of his Lexus by a sixteen-year-old hooker.

"Well, Betty, I don't think the government could hide a needle in a haystack. All we'd have to do is follow the red tape to find it. But there must be some particular event or occurrence making you so certain that aliens are taking over people's brains. What might it be?"

He heard her puff on her cigarette before answering, and took a sip of coffee to sublimate his own oral impulses.

"Well, it's, y'know, my *boyfriend* . . ."

Solomon toggled his mike off, sighed and settled deeper into his swivel chair as Betty launched into her melancholy tale.

UFOs. Elvis sightings. Scandals and disasters. Official plots of various color and odor, many sparked by misapprehended gleanings from CNN and the supermarket tabloids. Whatever the topic of the moment, a fair proportion of the calls came from people who were up after midnight and had no one else to talk with about their sad, perturbing lives of quiet desperation.

Such lives were a subject he was eminently qualified to discuss, being the bloodied veteran of four failed marriages, and part of a budding co-dependancy certain to bloom into yet another doomed marriage and psychocaustic divorce. Having an actual master's degree in philosophy was some help, as was the fatalism gained from possessing the sort of education which qualified you for a career in talk radio or sidewalk gibbering.

Still, one learns. Had he only discovered the legal legerdemain of the prenuptial agreement three wives back, he might not have been desperate enough to have taken the first slot available, gabbing the graveyard shift at a newish Public Radio station with more idealism than funding situated out in the middle of Nowhere, Arizona, USA.

When your own lawyer threatens to sue for nonpayment of fees you can't be overly fussy.

After Betty came Luis, who wanted to talk about the recurrent Microsoft monopolismic muddle, and how breaking

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up the software giant would only make things worse for consumers. Sol had endured several rounds of ill-conceived government mandated deregulation himself, and was inclined to agree with the man. Still, he threw in enough devil's advocate lines to keep the talk interesting to the soap opera and crop circle crowd.

Next came Daniel, freaked because of the epithets that had been spray-painted on his garage. Remarks making unkind reference to the fact that he was a white man married to a black woman. He handled Daniel with all the grace, delicacy, and useful information he could muster, inwardly cursing a society which would give someone in this man's situation no better place to turn than a stranger on the radio. Then came Steve, who was not only utterly convinced that a UFO had landed, but positive the rash he was experiencing was the result of alien nanomachines trying to colonize his groin. Solomon patiently extracted enough information to diagnose a malady with which he had intimate knowledge, namely hives, and prescribed Benadryl lotion as not only good for relieving the itch, but guaranteed to short out any microscopic alien invaders.

It was 1:52 when he took the next call, and he was thinking it might be the last one of the night.

"Hi, you've reached *Night Voices* on K-L-P-Y, Yavapai County Public Radio, 97.7 on your FM dial, where we're loopy, but not dangerous. Solomon Knight, Philosopher-at-Large at you service. Pitch me a conundrum. I'm ready."

"*Greetings Mister Solomon Knight on K-L-P-Y.*" The voice that came to him over his cans made him sit up straight, almost spilling his coffee. It sounded electronically altered, flat and echoing with odd off-key harmonics; a robot voice from a bad movie. He looked up toward Lori, found her staring back. He gave her the hand signal asking that she make sure the call was recorded, and the caller's number ID'd if possible. She gave him the high sign in return, telling him she was already on it.

Just over a year before a bomb threat had been phoned in during *Night Voices*. The caller, a conspiracy nut from Ash Fork named J. Edgar Hooper, had used an electronic device to alter his voice and sounded quite a bit like this caller. He had kept Hooper talking while Lori ID'd the number and dialed 911. Hooper was still at home and on the phone ranting merrily away when the cops broke down his door, and the bomb was located and defused before it could go off. Hooper's fingerprints were all over it, and now all over the bars of his cell. Lori got an Official Commendation from the Ash Fork Police Department. So did Solomon, and before the week was out, a parking ticket from the selfsame law enforcement agency. He took it philosophically.

"Greetings to you, my friend," he answered with professional nonchalance, wiping suddenly sweaty palms on his pants-leg.

"Thank you Mister Solomon Knight. It is most kind of you to give your life over to the consideration of questions posed by those in dire need of guidance."

"Hey, it's a living."

"My translator suggests that you have just offered an idiomatic expression, a mildly sarcastic, self-depreciating joke, yes?"

My translator, huh? Looks like we've got a live one. "My bank accounts are a joke, anyway. So what's your name, caller?"

"My name is . . . Rualf. Yes, you may call me Rualf." Then the caller made a sound that was probably a laugh, although the way the voice was distorted it might have been an attempt to swallow a live chicken.

"Okay, Rualf, the Philosopher is In. Why have you called?"

"I have considerable interest in your ongoing discussions about the space-

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craft sighted in your area. I have been following these exchanges quite closely."

"Always nice to hear from a fan." He was beginning to think maybe this wasn't a dangerous wacko after all. A wacko, quite likely, but probably not a bomb builder. Not enough steam in his pipes. When Hooper had called you could almost hear it coming out his ears. He looked up to see how Lori was doing. Tape and trace was probably still a good idea in case this turned out to be a budding Hannibal Lecter. She was hunched over her computer screen, absorbed in some technical thing. "So what do *you* think?" he continued smoothly. "Is it for real?"

"Oh, it is most certainly real."

"Did you see it?"

"I did not observe it in the sky in the manner of your earlier caller's best friend, but my awareness of the event was and remains painfully acute."

"So you think there are aliens here on Earth?"

"One, anyway." That maybe-laugh. "That I am aware of."

"Which variety? Adorable little ETs, or Purple People Eaters?"

"Neither. Fallible sufferers of misfortune would be a more accurate description."

"You're saying that while they're advanced enough to have spaceships, they're not superbeings intent on turning us into house pets?"

"Hardly. Remarks you have made, Mister Solomon Knight, lead me to believe that you understand the nature of thinking. That it is a process of winnowing useful concepts from a seething mass of inference and ambiguity. More advanced races simply have more advanced doubts; it is their acknowledgment of this, the curse of intelligence, which makes them more advanced."

Time for a subtle hot-button check. "By 'more advanced races' you don't happen to mean the Swiss, or someone like that do you?" Hooper had been convinced that the Swiss were an evil Master Race bent on achieving world domination by means of hoovering up all the money on the planet. He shrilly insisted that their so-called 'mountains' were really immense piles of cash cleverly covered with snow to confuse outsiders. His bomb had been set outside a Swiss bakery, concealed inside an old Swiss Miss instant hot cocoa canister.

"No, I speak of races other than your own, Mister Solomon Knight. Humans. Earthlings."

Solomon bit down on the impulse to ask the caller if they'd been to any *Star Trek* conventions lately. "And you're not one? An Earthling, I mean."

"So it is not immediately obvious?"

The green signal light from engineering was flashing, telling him that Lori wanted his attention. He looked up, saw her tapping her right ear. He toggled over to the instudio line.

"*Sol, this call ain't coming through the switchboard.*"

He frowned and shook his head, mouthed *What?* She shrugged and spread her hands.

"Sorry if I've been a little slow on the uptake, Rualf," he said, still eyeing Lori uncertainly. "I usually get most of my alien calls on Thursday nights, and it is kind of late."

"No apology necessary. I believe you jest with your first remark, and I am the first alien to call you. As for your assertion that it is late, you are more correct than you know. Time has almost run out." The distortion of the caller's voice did nothing to hide the ominous tone of this last statement.

"Time for what, my friend?" Maybe it was time for a fast rethink on that 'not dangerous' verdict.

"Time before I must act. I have monitored your broadcast for the past few nights, and have concluded that you are qualified to confirm the rightness of the decision I have been forced to make. Or perhaps you can convince me that my logic is in error."

"In error about what?" Solomon asked

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cautiously.

"My need to destroy myself."

This wasn't the first potential suicide Solomon had handled in over twenty-five years of talk radio, the last half of his career working the shift when the moon was out. But it was shaping up as the oddest.

"Harming yourself isn't the answer to any question," he began in a kindly tone.

"I agree, though in my case I believe it is the only solution to a most difficult problem."

"Well, let's talk about it. Maybe we can find some other way. Two heads are better than one—unless you have two to begin with, being an alien and all. If so, then we got three between us, and a damn good head start on the problem."

"I assure you that we have but two heads between us. Perhaps that will be enough. Very well, let me begin by stating that the UFO which has so troubled the minds of certain listeners is real. This I know because I am a crew member on it. It is—or at least was—a genuine interstellar craft manufactured over a thousand light-years away. I suppose its present condition might disqualify it from still being called a spacecraft; the rules you use for renaming things after a state-change have more than once baffled my translator."

"So your ship is totalled?" His tongue was working on autopilot for this question, his left and right hemispheres wrestling with the concept of this being an actual alien on the phone. Rational right was on top, but left, whose sneaky moves had gotten him into much trouble over the years, wasn't down for the count just yet.

"Totally totalled, if that is a permissible usage."

"Works for me. Was anybody hurt?"

A sound that could only be a sigh. "I am the lone survivor from a crew of four. We had a pilot, navigator, propulsist, and myself. My position is . . . there is no single word in your language to describe it. Call me a *lifeist.* It was my function to oversee every facet of the crew's well-being, and my duties entailed those of cook, physician, psychologist, philosopher, priest, and entertainer."

"So your three friends are dead?" Dumb question, but he was stalling for time as he watched Lori slip quietly into the studio and head toward him. He lifted one eyebrow in question. She shook her head and held up a single finger. *Wait a minute.*

"Yes, they perished in the crash."

"That's awful. Are you hurt?"

"In spite of the violence of impact I suffered only minor injuries. They are not life threatening, and I have already treated them."

"I guess you were lucky, weren't you?"

Another sigh. "Death would have been kinder, Mister Solomon Knight. Continuing life has left me with a dire responsibility. One that weighs heavily on me, and prompts my seeking your counsel."

"Well, I'm listening," he said, watching Lori fiddle with the big twelve-line phone. All the line indicators had lit up since he'd begun speaking to Rualf. No big surprise there.

"This is a most difficult matter to discuss. I possess the words, but my will fails me."

"Just take it slow and easy." As those words were leaving his mouth Lori unplugged the phone. All the lighted pads went dark. "What the hell do you—" he began angrily, lurching forward in his chair.

"I will do my best, Mister Solomon Knight," Rualf continued over his headset.

Which was linked to a dead telephone.

He stared at Lori. She stared back a moment, then put the phone down and reached into the pocket of her flannel shirt, pulling out a battered pack of Marlboros. When she held it out toward him he nodded.

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"Next we must discuss matters of biology," Rualf said as Lori lit two cigarettes and handed him one.

"Uh, sure, I'm a real big fan of biology. Even have one of my own." Lori plugged the phone in once more, then headed back to her boards. He tried to distract himself from the sinking feeling that he was getting in way over his head by focusing on the way her butt filled her tight jeans. No joy. He had a suicidal alien on the line, and more earthly matters were on hold.

"Once again you try to make me feel better with your banter. You could be a lifeist yourself, Mister Solomon Knight."

"The priest part would disqualify me," he replied, parking the cigarette—which tasted equally like pure heaven and burning compost—in the corner of his mouth, then reaching into his jacket's inner pocket for the pint of Jim Beam he kept there for those 'problem broadcasts.' A clear violation of FCC rules, but getting busted was about the last thing he had to worry about now.

"Do not be so sure. Back to the matter of biology. Let me begin by stating that our physiology is at once quite similar and yet radically different from yours. We are carbon-based, oxygen-dependent, and built around a substantial water component. I could breathe your air for a short time, although the oversupply of nitrogen would soon have a deleterious effect."

"What do you look like?" Solomon asked, then took a healthy swig of nerve tonic in case he needed help dealing with the answer.

"To ourselves we are comely, although your kind might not find us so. It is difficult to predict. Is not one of your aphorisms 'Beauty is in the eye of the beholder'?"

"That's what they say. By the way, are you male, or female, or . . . what?"

"By your standards I am both, and neither. I would gladly discuss this topic in greater detail, but the press of time forbids it."

"What's the hurry?"

"Attempts to locate our damaged craft are about to reach their conclusion. The range of the piece of equipment you would call a 'camouflager' or 'cloaking device' has been severely impaired. Soon those who seek me will stray inside its protective radius, and I will be found."

"You don't want to be rescued?" As soon as those words left his mouth he flashed on what it might be like to be an alien and fall into the hands of the government. "Or are you afraid you'll be turned into a science project if they find you?"

"I fear the situation is more complicated than that."

"Are you afraid that we'll use the wreckage to figure out a way to go back where you came from? You sound like a reasonable being, so I imagine the last thing you'd want is the likes of us ringing your planetary doorbell."

"Certain . . . factors make your unravelling our technology an absolute impossibility."

"Well, come on friend. What's the problem? Spit it out."

"Yes, I dare not hesitate any longer. The press of time precludes reticence. Our world is quite different from yours, Mister Solomon Knight. It is host to a level of biological activity you would find terrifying and incomprehensible. While your world is home to similar types of microbiota, things known to you as bacteria, germs, viruses, fungi, and amoebae, they are rare and harmless compared to the virulence and ubiquity of analogous denizens of our world. Such threats to you as your Ebola virus, HIV, anthrax, influenza, and flesh-eating staph would not even be considered minor irritants where I come from."

Solomon had a hazy idea what this might mean, thanks to a lot of reading, a lot of listening, and a brief, misbegotten marriage to a general practitioner in Indiana. "So . . . you're saying you are immune to stuff far nastier than the worst

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we have to offer."

"That is correct. We carry immunity to a vast spectrum of virulent ills, the majority utterly unknown to you."

The inference was inescapable—and chilling. "So you probably also carry those diseases. Your monster versions of them." That out he took a last drag on the Marlboro, crushed it out on the floor, then took a calming swig of Jim Beam, thinking about how the Spanish Conquistadors had killed off as many native populations with the diseases they carried as with their swords and spears.

"You are correct, Mister Solomon Knight. I am deeply sorry. It was never our intention to enter your atmosphere. Our mission was to remain hidden and observe. But we overestimated our ability to defend ourselves against the intense corona of man-made electromagnetic signals swaddling your world. We moved unaware into a pocket of especially intense activity. The filters on our sensors were overwhelmed. Stray signals leaked into our inner systems and caused a problem with our propulsive controls. By the time our pilot and propulsist were able to locate and correct this problem it was too late. Crash was unavoidable."

"So we winged you by accident and brought you down."

"Yes. You meant no harm. We meant you no harm. Now we are left with the potential for terrible harm."

"What kind of harm are we talking about? How bad?" He had a sinking feeling he knew the answer, but hoped he was wrong.

"Our microbiota would lay waste to the native life-forms of this world with an appalling speed and ruthlessness. According to my projections all but a handful of humans and most mammals would be dead within twenty days. Any survivors, along with fish, reptiles, insects and other lower life-forms would be extinct before another seven days elapsed."

"Just from contact with you." The words tasted like ash in his mouth.

"That and from contact with my dead comrades. Upon death the constraints our biological systems put on these inimical fractions fail. The corpse becomes a sort of biological hothouse, breeding strains which can threaten even us—or you. We immediately burn our dead. Our ship is equipped with a crematorium so that if a member of the crew dies their remains can be incinerated before it becomes a hazard. It did not survive the crash intact. I am here with three dead, each gone into that stage which we call *aalaro.* Each could be considered a biological bomb capable of reducing your planet to a seething wasteland bereft of its original life forms."

Solomon had been staring at the lit ON AIR sign. This was being broadcast for hundreds of miles by KLPY's powerful main transmitter and four widely spread repeaters. Anybody could be listening in. Like the good folks at Fort Coggins, which had a shady, largely unacknowledged reputation as a producer of Better Weapons for a Better Future. He could say this was a gag, sign off, and finish in private. Maybe he even should.

But he couldn't bring himself to do it. This was the radio talk of his life, the conversation to top them all. How could he silence it? Besides, if the Army or whoever *was* listening, maybe what they were hearing might make them back off.

"Could the dead be, ah, contained?"

Rualf's answer was immediate and unequivocal. "You do not have the technology."

"Not even the biological weapons people?"

"We have bacteria and fungi which would eat the materials from which you construct your containment, and on such a rich diet, reproduce at a rate your experts would insist was impossible."

"So you're saying that anything our people did would be like drawing a chalk circle around the problem and

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dancing naked to keep the evil spirits in?"

"This is correct. Your present technology would be no more effective than this rather odd method you propose."

Solomon sighed. "So where does this leave us, my friend?"

"In dire circumstance. It is a certainty that this craft will be found soon. My admittedly brief study of your race's habits and inclinations leads me to believe that sooner or later an attempt will be made to breach the hull to find out what is inside. That will release your doom. Any attempt to move this craft presents equal risk, as its structural integrity is severely compromised. Even if caution prevails and a less direct approach is taken, I cannot predict which sensory devices brought to bear might make containment fail, just as our drives were lost to our control. The existence of this ship presents an extreme risk, and given your natures, an irresistible temptation. Thus I am reduced to a single option."

"Destroying yourself," Solomon said with a heavy voice and leaden heart. "I assume you plan to do this in such a way that it, um, sterilizes the biological hazard you pose."

"That is correct."

Lori's heads-up light was blinking again. He looked toward the control booth and saw her making the handsign for an urgent call. He shook his head. Rualf wasn't the sort of caller you put on hold. She grimaced, leaned over her mike.

"*I think you better take this one, Sol,*" boomed over the studio speakers. "*It's a bigshot who cut everybody else off.*"

Line one blinked for his attention. Just as Lori said, all the other lighted pads had gone dark. This did not bode well.

"If you'll excuse me for a moment, Rualf, it looks like I have to take another call. But I'm keeping your line open too, so stick around and jump in if you feel like it."

The sound the alien made was definitely a laugh. The sort of laugh he made when served with divorce papers. "I am not going anywhere, Mister Solomon Knight."

"Good." He punched the button for line 1. "KLPY, speak your piece."

"This is General Richard Avon, Mr. Knight. Before I begin, I must insist that our conversation does not go on the air."

Solomon leaned back, took a sip of Beam. "No can do, General. This is Public Radio. We talk in public, or not at all."

"Listen, Knight, I order you—"

He laughed. "General, save your breath. I was 4F during Vietnam, and I've probably degenerated to something like 10F now. You'd have better luck ordering a brick around. Say what you have to say, or I'm going to shut you off."

Over his headphones came a sound that was half sigh, half growl. "Very well. Stop your broadcast with this alleged alien. *Now.*"

"I don't think I can do that. Sorry."

"I *order*—"

"We tried that one before, remember? Any other suggestions, Dick? I'm always open to suggestions."

"You must immediately cease agreeing with this alleged alien that it should destroy itself. Continuing to do so will be considered an act of *treason.*"

"You mean an act of reason," Solomon shot back with a sigh. "Haven't you been *listening?* Letting you guys get your hands on Rualf would be like handing a bunch of chimps a fucking crate of nuclear weapons."

"I assure you that if this alleged craft does exist we are prepared to take all due precautions."

"Nope, he hasn't been listening," Solomon said to the alien and his listeners. "Got his head up his—"

"Now *you* listen, you treasonous bastard!" General Avon bellowed. "I have troops on the way to your studios right this very moment! If you do not obey voluntarily you will be *forced* to comply.

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At gunpoint. Got that?"

"*Resistance is futile,*" Solomon quoted cheerfully, punching out on line one. The button immediately began blinking again, but he ignored it.

"Well, Rualf," he said as he leaned back in his chair. "You were worried about what might happen if you were found. Feel better about it now?"

"I do not, Mister Solomon Knight. The moment of my discovery draws ever nearer. Very soon now I must take steps to neutralize the threat my kind poses to yours."

"I'm afraid you're right. Sorry."

"Please, do not make your decision just yet. You are not yet in possession of all the facts."

"I never am, but rarely let that stop me. Okay, what else should I know?"

"To release sterilizing energies I must invoke a special preconfigured imbalance in the ship's engines, in effect attempting to make an overpowered dimensional translation in a prohibitively strong gravity field. The containment fields will collapse, releasing an enormous but short-lived burst of energy."

Solomon got the general drift. "In other words you turn your ship into a bomb."

"Yes."

"How *big* a bomb?"

"Quite small compared to some your race has constructed, but still the resulting ball of superheated plasma will cause terrible damage to the surrounding area."

"How big an area are we talking about?" He turned his chair to take a look out the studio's single window, site of his occasional 'Eyewitness Weather' spots. Off in the distance a string of small lights wound its way toward him. Troops sent by General Avon, no doubt. He wondered if his lawyer was any better at treason or whatever than divorce. Probably not, especially in light of how much money he was still owed.

"This is not my area of expertise, Mister Solomon Knight. The best I can offer is an educated guess."

He turned back to check on Lori. The face under her green-tinted hair was pale and frightened. "Guess away," he said, waving her into the studio.

"I would estimate that anything within half a mile of my present location will be instantly vaporized. Everything within a ten-mile radius will be utterly destroyed by a combination of intense heat and shockwave. Everything within a fifteen-mile radius faces almost certain destruction from debris, and remaining shockwave and heat. It is only past that fifteen-mile mark that people or structures have any chance of survival, and past the twenty-mile mark that the odds of survival outweigh those of becoming a casualty. Radiation from the blast will be minimal, and there will be no toxic fallout."

Sol licked his lips, the mushroom cloud visions imprinted on his brain as a child of the fifties and sixties blossoming in his head. "That doesn't sound very good." He leaned over and retrieved the second swivel chair kept in the studio for the morning duos and the occasional interview, indicated to Lori that she should sit beside him.

"It is a terrible prospect," Rualf agreed heavily as the engineer dropped into the chair beside Solomon. He offered her the bottle, and she took it. "It is only tolerable in light of the alternative. This is a sparsely populated area, but the villages of Sparksy and Durwood lie within this zone of devastation. The ship's sensors have been compromised, but function well enough to provide me with an estimate of potential casualties. That number is over 1,500 but less than 2,000, and includes the armed searchers who are so close now that it can be only moments before they find me."

"Over 1,500 lives," Sol echoed bleakly, watching Lori take a calming slug of bourbon. When she lowered her head and opened her eyes he gestured for a cigarette. "Against the lives of how many billions? No contest. You've got to

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go through with it."

While Lori was lighting smokes for the both of them he turned to check on their situation. The string of lights was much closer now, and coming fast. "You're a brave, ah, person, Rualf, and the act you contemplate is one of kindness and brotherhood."

"Please, I must provide you with one final piece of information before I can accept your decision."

He accepted the Marlboro from Lori and took a puff. You didn't need to be a philosopher to hypothesize what was coming next. Being a fatalist was more help. "What's that?" he said, exhaling smoke.

"Your present location is within eleven miles of mine."

"For once I get front row seats to a big event," Sol said with a mordant chuckle. "So if you push the button my lovely assistant and I are toast, too?"

"You will die, yes."

"What about the cellar?" Lori put in plaintively. "It's an old fallout shelter. Wouldn't we be safe there?"

"I am so very sorry," Rualf replied softly. "I have probed the space of which you speak. Taking refuge there would only make your deaths more painful and prolonged." A pause. "So what do you say now, Mister Solomon Knight?"

Sol looked into Lori's eyes, saw the tears gathered there. She had a mother and brother living in Sparksy, and her boyfriend lived and worked in Durwood. He took her hand and tried to smile. She tried to smile in return, and with her free hand held the bottle of whiskey out toward him.

He took it, allowed himself a meditative sip. His namesake, the old Biblical judge, never faced a decision like this.

"Well," he said in a voice free of tremor or doubt, "It's been a pleasure knowing you, Rualf. I want to thank you for the sacrifice you are making on our behalf, and apologize for making you crash in the first place."

There was a long silence, broken when Rualf said, "I am found at last," in a low, hopeless voice.

"So are we, brother: General Avon's come calling, and I don't think it's to sell us some nice perfume." Lights flashed through the window and strobed across the ceiling. Stretching his neck he was able to see that the parking lot was full of trucks, jeeps, and armed soldiers.

"Devices which my sensors identify as various means of forced entry are already being brought into evidence. It would seem my warnings have gone unheeded."

Sol exhaled a lovely stream of carcinogenic smoke. "No surprise there. You seemed to have figured out our kind from the get-go."

"I had hoped to be wrong."

"We've got two ears and two hands. Only our hands are bigger than our ears, so we tend to act first and listen later."

"Not all of you. I thank you for the way you have listened, and for your help with this most difficult decision."

"Glad to lend a hand. Or an ear."

"I so wish this meeting between our two kinds could have turned out differently."

"You and me both, brother. But anybody with half a brain who hears this should see what good people your kind are."

"Thank you. I am initiating the self-destruct sequence . . . now. There will be a short delay before detonation."

The studio's soundproofing was good, but it could not keep out the sound of the broadcast center's front doors being blown in. Sol stood up, drew Lori to her feet. Hand in hand they walked to the window.

"Well, you heard it here first, folks," he said to all the good people out in Radioland, some of whose death warrant he had just cosigned. "Tonight's broadcast is going to be our last *Night Voices.* So on behalf of our engineer Lori Polowski and our new alien brother Rualf, this is Solomon Knight, Philosopher-

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at-Large signing off. I want to leave you with one final thought: *Shit happens.* All we can do is clean the mess up afterward the best we can."

He put his arm around Lori, and together they leaned closer to the window. She huddled close, trying to smile even though tears ran down her cheeks. He had a sudden urge to ask her to marry him, and had to laugh at this product of his own peculiar and absurd survival instincts.

"Goodbye, Earth," Rualf said quietly. "I am honored to have met your kind, and overflowing with regret at how this first meeting between our two kinds has to end."

"Yeah, maybe next time you'll have the good sense to crash on Mars. Their army is a lot smaller. Microbe-sized at best."

A last laugh from the last caller to *Night Voices,* then in a quiet tone: "It is time."

Sol gazed out the window. He ignored the frenetic activity below, just as he ignored the sound of rifle-butts hammering at the outer studio door. Instead he looked up, and out.

The sky was black as death, and alive with sparkling stars. Which one was Rualf's home? How far had he come, only to have it end like this?

A heartbeat later the horizon was cleft by a rapidly expanding ball of cleansing white light.

Solomon Knight, radio talk show host and philosopher-at-large, found himself thinking with growing wonder that what he now saw was the pure white light of brotherhood. A brotherhood that spanned the distance between stars.

He was smiling when the furious energy loosed to save his world gathered him up in its purifying embrace.■

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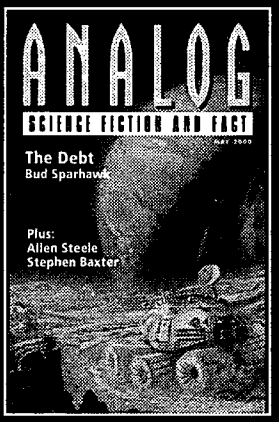

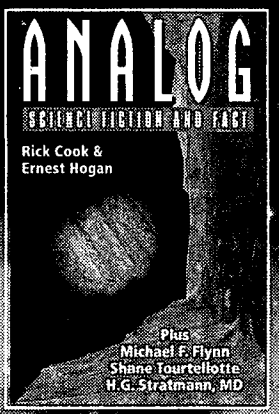

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SKY CITY

Alexis Glynn Latner

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Inheritances can take many forms, and their nature and uses may not be obvious.

illustration by Vincent DiFate

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The rented landflyer skimmed the foothills of the Endish Range under a ceiling of featureless gray cloud. Carolinna dela Manta had a wide view of the barren landscape through the flyer's canopy. Across the lowest slopes of the mountains trailed ancient rock walls, as meandering and aimless as though, two millennia ago, they had been flung down out of the sky like so much string.

None of the sketchy ruins suggested the time-eroded foundations of a city.

Distracted, Linna almost let the landflyer brush the jagged crest of a wall wandering over a hill. She jerked the thrust lever up. The flyer grudgingly lifted itself over the obstacle. An outdated but serviceable model rented from the trading post just a few hours ago, the flyer was a perfectly adequate platform for Linna's work here. But the survey wasn't starting out the way she'd hoped.

Linna opened her notebook. "Initial aerial survey of the ruins is inconclusive," she dictated. "There's no evidence of a starport-industrial complex. Despite the central role of Cloud Sky City in the mythology of the Endish natives, it's not obvious that their ancestors constructed a city in this location in the Colonial Age."

It was of course possible that the myth of Cloud Sky City had no historical basis. The annals of archaeo-history were full of dead ends. But Ende, she silently vowed, would not be one of them.

Cold air probed the edges of Linna's cold-weather coverall. The flyer lacked cabin heating, and it was early spring on Ende, warmer than Endish winter but frigid compared to anywhere else.

She tilted the flyer over the shoulder of a low ridge. More walls skeined away downhill. "The purpose of the extensive wall structures is unclear. They might have been field terraces to start with, but if so, have been abandoned. The natives subsist by fishing and harvesting plants in a huge lake." Far away, she could see the slate-colored Lake of Ende.

Suddenly Linna flashed back to her summers as a young girl, camping beside sun-glazed blue lakes on her home world, New Catalunya. The rocks that previous generations of campers had arranged—big stones piled up into seats, ringed around campfires, laid down to line ditches—had fascinated her. Campground stones had sparked her dream of becoming an archaeo-historian. She wanted to discover new ruins of the old Colonial Age when the human race crawled away from Earth across the stars, slower than light and with hopelessly high hopes.

The Colonists settled on as many as twenty scattered worlds, and tumultuous centuries passed on Earth until the unexpected invention of fast starflight. Whereupon Earth set out to conquer the stars, in the process rediscovering its old colonies: some extinct, some flourishing, most somewhere in between, a function of how hospitable or marginal a planet the Colonists had stumbled onto in the first place.

Ende's name was an anagram of "Eden." Never had the hope of paradise on the other side of the stars been as misplaced as on Ende.

Air turbulence brought Linna back to the immediate present with a jolt. The walls, higher in this area, blocked the wind and made it eddy and uplift.

Rough stones fitted together with no apparent mortar comprised the walls. It was primitive construction, and much the worse for centuries of weathering. Lichens laced through the stones might be doing more than their share to keep the walls standing.

The flyer's remote sensing equipment consisted of one camera. At least the crude device had a notebook connection. Linna quickly programmed the notebook to diagram the walls surveyed so far.

She frowned at the resulting image on the notebook's tiny screen. The walls traced across the mountain foothills in a

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very roughly semi-circular way. The walls could have been centered on something important. But the focus was empty: the only thing there was kilometers of barren slope between the walls and the slate-gray lake.

Disappointment—no less acute for being premature—grew into a lump of ice in Linna's stomach. Maybe there had never been a Colonial city here. And if not here, then nowhere on Ende. Only this region had ever been colonized.

If Cloud Sky City had never existed, it didn't matter to Ende, a world harsh enough to have shrugged off any Colonial attempt at a city. But it mattered a great deal to Linna. She'd studied at the great old University on Terra with enough distinction to be awarded a much-coveted prize, which she'd used to fund a one-woman expedition to Ende to look for Cloud Sky City. Her friends and colleagues had thought it was a breathtaking gamble, but that Linna dela Manta could pull it off if anyone could.

No matter how she altered the parameters of the map, her notebook still showed the sprawling complex of walls to be roughly centered on empty, steeply sloped, featureless land. Exasperated, Linna tossed the notebook into the luggage web. She checked the flyer's fuel gauge—it read only a third down, which was what she expected, since she was halfway through her planned flight—and continued flying her survey grid. Ende had only recently been rediscovered. No archaeo-historian had been here before her. Something undiscovered had to be here to study and learn from. And she would find it.

On a ridge of land ahead of the flyer rose a wall bigger than the rest, with an odd design etched on its face. It looked as though the wall bore a corrupted frieze. She flashed to the guess that it was a remainder of an ancient marketplace. Or, more plausible: the ruins of a religious shrine, a sanctuary. What form would religion take at the end of a long star flight to the bitter end of the attainable universe? Energized by anticipation, she briskly swooped down to land the flyer in the wind lee of the big wall, descending on a torrent of down-ducted engine thrust.

Linna instantly saw that her "frieze" was only a scribbled expanse of lichens. For all its height, looming a good ten meters above the flyer, the wall was just more dark gray rockwork.

Mortarless.

Unstable.

Shoved by the flyer's landing wash, the wall swayed against the milky sky. Linna watched in horror as lichen threads stretched and snapped. Thrust-up to takeoff would take the old flyer twenty seconds—too long! She hurled herself at the flyer's door and jerked it open.

Harsh thundering noise assailed her. The roof of the flyer sagged. Terrified, she wriggled out of the seat and dived onto the flyer's floor. The sagging roof propped itself on the empty seat frame, which gave a shrill groan. Then the awful, hammering thunder trailed off.

The instrument panel, jammed up against the crushed seat, sizzled. A wisp of smoke curled out of it. Spilled fuel, loose wires, she thought disconnectedly. What if it caught fire?

The door was crumpled, but ajar. Frantic, Linna crawled out of the flyer, heaving fallen stones aside to escape from the machine.

Behind her heels, the flyer erupted into fuel-fed flame. Linna scurried away from the hard heat.

Notebook, she thought numbly, sitting up on her heels. Notebook? She desperately searched the pockets of the coverall. She found her survival kit and her radio, but not the invaluable notebook that contained not only her preliminary findings so far, but all of her research about Ende.

She'd tossed the notebook into the luggage web. The notebook's circuits would have been fried by the fire. She

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stared mesmerized at the burning flyer, incredulous at her own stupidity.

The flyer dimmed and dwindled to a shapeless lump of metal and plastic. Cold washed around Linna's feet, like undertow exploring someone wading on a treacherous shore. The intensifying sensation scared Linna into thinking more clearly. She picked up the radio, fumbling with the boxy little device.

A piece of it came off in her gloved hand. Unnerved by the broken bit, Linna desperately tried to activate the radio.

It didn't work. It was broken.

The radio had been stowed in a pocket on the left side of her cold-coverall. And her left hip ached ferociously. She dimly remembered the nearly crushing force of the roof of the flyer. The radio had been in the wrong place, briefly but disastrously ground against her hip.

Linna stared up at the empty, milk-blue sky. Accident without immediate help was incomprehensible. On New Catalunya, the air net would have vectored help in at once. And red-and-blue parrots would have flocked to the scene to scold the careless flyer. Here there were no parrots, no people, nothing but gray desolation.

She remembered being told that the flyer's transponder-locator wasn't working. She'd idly suspected that the flyer was usually rented to shady prospectors who didn't want their whereabouts known. But she'd shrugged it off, knowing she had a survival kit and a radio

Linna started shaking. The flyer was ruined. She was stranded. In the field. On the farthest frayed end of civilization. Suddenly she couldn't swallow. She grabbed the disregarded survival kit and opened it with shaking hands to assess the contents. Food cubes. Firestarter. Water pouch. Tent.

She could survive. And she wasn't badly hurt. She could hike toward help.

The trading post lay on top of a mountain, but she wasn't sure which one. She couldn't walk back to the post without knowing where it was and how far. The opposite direction was a better bet. The natives living near the lake might help her.

She could see the great lake in the clear distance. What looked like tiny rafts of debris on the near shore were the Endish villages, too far away for people or even buildings to be distinct to Linna's eyes. Taking a deep, shaky breath, she started walking downhill.

Downhill would go to the lake. Eventually. Mentally Linna kicked herself. She'd made a series of mistakes, starting with substandard emergency equipment and ending with a careless landing. She knew better. She'd worked in the field before. But she'd let herself be distracted by the unpromising-looking locale. Linna cursed herself for letting disappointment evolve into unmitigated disaster.

Hours later, Linna was stumbling with fatigue and the lake looked no closer than before, the villages still distant and indistinct, like flecks of wood washed up by the water. She had a worsening headache—she must have hit her head on something when the wall crushed the flyer. Now every step she took jarred the bundle of pain in her head. Above, gray clouds massed in the sky, blotting out the sinking sun and its wan warmth. Without direct sun, the whole landscape faded to dreary shades of gray.

Dread clutched Linna's lungs. She could die on Ende.

She fought off panic, reminding herself that she had the kit with tent, food, and water. She could survive a night on Ende. But the emptiness and loneliness of the world appalled her. Linna ignored the headache and the pain radiating from her badly bruised hip and staggered on.

The chill breeze made her eyes tear. She was struggling ahead in a blur when someone stepped in front of her.

Linna halted in shocked surprise. He had the stocky build of Endish natives, and native clothes—leggings, a hooded parka, thick animal-skin gloves.

"Hello," she gasped. Most of the na-

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tives supposedly understood the trade-pidgin used at the trading post. And it was based on Panglish. Desperate to communicate, she blurted, "I was flying—I was looking for Cloud Sky City. A wall fell on my flyer. I need help."

He backed a step away from Linna. A short bow hung on his belt. Small dead animals dangled from a thin rope slung over his shoulder, dripping blood onto the gray ground in red spatters, the most vivid color Linna had seen on Ende. He turned away from her. Before Linna could cry out in dismay, he looked over his shoulder. "Come home."

Trade-pidgin was a skeletal language. The hunter probably meant *come to my home*. Hurt, shaken and desperate, Linna started after him.

She followed him for what felt like days but might have been only an hour or so, and he never touched her, but never got far ahead of her. He waited for her to painfully pick herself up when her foot slipped on a mossy rock and she fell. He glanced back at her often. His eyes seemed unnaturally bright, as if he had a fever.

It finally surprised Linna when he halted at a dome of earth. She looked around dazedly. The earthen hovel was isolated, nowhere near anything else that looked like a dwelling, or anything manmade at all.

Linna felt afraid. But the natives of Ende rarely harmed outsiders.

The hunter reached out to a stiff curtain hanging in what looked like the hovel's doorway, half as tall as a person. "Come home," he said again, his eyes shining bright. Disconcerted but having no alternative, she crouched to go in.

The warmth of the hovel, relative to the bitter cold outdoors, came as a shock that swept Linna's remaining strength away. Half-conscious, Linna tumbled into a pile of furs on the hovel's floor. The furs smelled strongly, like smoke and food and life.

Every morning, the relentless grayness of Ende pushed Linna closer to the brink of despair. The afternoons were tolerable—it was Endish springtime, as warm and bright as the climate would ever get. But the headache she'd had for days was always worse early in the morning, and every day on Ende dawned as empty, gray, and chill as death. Today was no exception.

Carrying an empty water bladder and clumsy in the windless cold, Linna trudged along a faint trail on the moss-mottled ground. The trail paralleled a wall made of ragged stones. Featureless otherwise, the gray-green land stretched up to the mountains, their heights cloaked in dismal cloud.

In a stunted tree beside the wall, a dull little bird buzzed. It was a bitter antithesis of Catalun parrots, and it pierced the aching fog in her brain like a knife. She stumbled on a loose rock, caught herself on the wall with a painful jolt, and stood paralyzed. *What would Iste think if I died? Do ghosts die in his mythology?*

A stubborn ember of hope flared in Linna's mind. Pushing herself away from the rock wall as though it were the bulk of her despair, Linna followed the trail. The water bag, made from the bladder of a giant fish, was awkward even empty, too thick to fold, too slick to grip easily with gloved hands. She wrapped it in her arms like a baby.

The bird in the tree abruptly cocked its head to peer down at something on the other side of the head-high wall. She heard a crackling scuff like something heavy moving on the moss.

Iste had gone to fish in a little boat on the great lake. She was alone. Linna's skin prickled. She approached a narrow gap where the frost-heaved wall had fallen apart. Hugging the edge of the breach, she warily peered across the spilled stones.

An enormous four-legged creature glared back at her. It lifted its shaggy head, baring fangs.

With a gasp, Linna stepped backward,

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then bolted toward Iste's hovel. The beast shadowed her on the other side of the wall, moss crackling under its fast-moving bulk. Linna shoved her way past the skin in the hovel's narrow doorway. She huddled inside, shivering in terror, glad the hovel had thick earthen walls.

Finally something parted the door-skin. She jumped. But it was Iste. Reeking of raw fish, he peered into the gloom in the hovel. The only light came from the smoke hole over the cold hearth. Iste saw the empty water bladder and scowled. "Bad woman!"

"There was a big animal," she stammered. She didn't know the trade-pidgin word for what she'd seen.

Iste snatched up the water bladder and left. When he returned later, with a full water bladder, he said, "Red-bear was here." His face had smoothed into the unreadable mask that was Iste. He poured water into his cooking shell. "Make fire."

With the electronic firestarter from her survival kit, Linna lit a tiny bundle of tinder on the hearth, her fingers clumsy with cold. The firestarter was good for a thousand starts. The counter said seventeen.

Every day Iste demanded a brief morning fire and a slightly longer evening fire. She'd started Iste's fires for eight days. Even the first time, when he'd demanded that she make fire and she'd resorted to the firestarter, he hadn't marveled at the device. It was her job to start the fire; whether by normal or magical means seemed immaterial to Iste.

He dropped what looked like wrinkled marbles, the root called hodo, into the water in his cooking shell. Feeding bits of peat to the little fire, Iste kept the water boiling long enough for the hodos to soften. Meanwhile he laid strips of raw fish beside the fire.

With a shiny tin ladle, Iste dipped out boiled roots and laid them together with pieces of charred fish on two shiny disks, scales from a giant fish. He gave Linna a scale loaded with food. They took turns drinking hot starchy water from the ladle.

The food and water stilled Linna's shivering and cleared her mind. Red-bear was the pidgin word for an Endish ursoid. The animal she'd seen, pony-sized, with thick legs and reddish fur, matched what she now remembered shown in the orientation holo. Red-bears could wrestle a giant fish or a lake-seal out of the water to devour on shore. They occasionally attacked a seal-sized human. With a shudder, she imagined fangs and claws shredding her flesh.

"You see red-bear where wall fall down."

"Yes, then I ran back."

"Red-bear follow. Tracks to here, unhn," he grunted. "Good woman. Run fast."

Linna felt absurdly elated. Her nerves knew she'd survived a brush with death today. Her stomach, which had been painfully slack, registered warm fullness. It was unaware of the shortcomings of Endish food. The natives subsisted on a sketchy ecosystem that lacked several nutrients essential to outsiders.

"Red-bear go away," said Iste, in an almost conversational mood. "Everybody lake-by better watch out. Lining-up time make red-bear mad."

On this moonless world, the natives marked time by the positions of the sun relative to its distant red companion star. At this time of the year, the two stars aligned in the sky, the chip of ruby glare eclipsed by the wide weak yellow disk of Ende's sun. With Ende pulled marginally closer to its sun by the gravity of the red double, there followed what passed for spring. "Do you mean the red-bears are irritable and restless? Why? Is it their mating season?"

He scowled. "You forget too much."

"I'm not a ghost," Linna protested. "I'm from a world like this one, except warmer, with more people."

"World is world. Dead people go to Cloud Sky City and forget everything

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from here. Sometimes come back, though."

Unlike primitives before the Star Age, the degenerate native culture of Ende imagined heaven as a city. It was their attenuated memory of the cities on the Earth their ancestors abandoned.

She'd tried to reason with him before. It was worth trying again. "You use a new tin ladle. And steel needles. Those things came from Outworld. My firestarter isn't magic. It's just a tool, like your knife." She waved the firestarter for emphasis. "Why can't you believe I'm just an outworlder, not somebody back from the dead?!"

"Got skin like us," he replied.

True, most of the trading post personnel had darker or sallower complexions than Iste. But most of the millions on Linna's homeworld had light brown skin, just like hers and much like his.

"Got eyes like sky. Eyes turn blue in Cloud Sky City," Iste said with the irrefutable illogic of delusion.

Maybe this gray hell was Linna's own afterlife. Hoping to discover a forgotten city on Ende, instead she'd found hundreds of kilometers of rotten rock walls and a crazy man who thought she was his dead wife. Tears pricked her eyes. He hadn't pressured her for sex. She didn't know what she would—or could—do when he did.

"Red star in lining-up time where bear not see it," said Iste. "Red-bear get mad."

Every day Linna had tried to convince him to take her to the trading post. But he wouldn't budge from his mad convictions, woven from the superstitious beliefs and the cultural mores of Ende. So she'd started planning to escape from him.

At first she'd suffered from strained muscles and foot blisters from the long hike to find help. Those had healed. Even her injured hip felt pain-free yesterday, once she warmed up and moved around at midday. Her chronic headache lingered on, but it was bearable. But Iste's warm, smoky hovel seemed safer than wild Ende. She'd not tried to escape so far.

The cold truth finally came home to her, unfolding in the center of her body, crowding out her breath. From here on, her physical condition could only deteriorate, worn away by too little food and too few vital nutrients, and the daily battle against cold she wasn't adapted for. She could cower in Iste's hovel indefinitely while death, as insidious as malnutrition or as brutal as the inevitable Endish winter, waited for her just outside the door-skin. Or she could try to escape. But that had to be soon or never.

Iste was crazy. But he was cunning enough to leave her alone only when she could not escape. He went fishing in the distant lake early every gray-palled morning, while Linna woke up stiff with cold and weak with hunger, barely able to fetch water. By noon, the clouds unveiled a pale blue sky and Iste came home to mend nets in clear midday weather. Brighttime, he called it, the only part of the day with light and warmth enough to make it feasible to do handwork out of doors.

Iste fetched net-making materials from a cache nearby. Linna surreptitiously checked her own cache, a hole scraped out under the ragged rock wall. She was afraid the red-bear might have raided it. But her hoarded food lay undisturbed. Maybe the red-bear hadn't wanted hodos and two foil-wrapped nutrition cubes. The bear was, after all, a voracious carnivore.

A thin yellow flare arced across the blue sky, marking the trajectory of a distant ship in ascent toward orbit from the trading post's mountaintop landing field. Linna intently noted which peak it was: the flat-crowned, big-shouldered mountain directly opposite Iste's hovel from the distant blue-gray lake.

From here she could see distinct huts and longhouses in the nearest lake village. But with Ende's annual slight

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warming, ice marshes around the great lake thawed and treacherous bogs opened up. The villagers knew safe ways around the bad places, but according to Iste the bogs had already claimed a stray pony.

The land between Iste's camp and the mountaintop was rocky and raw, relentlessly cold, but solid. And the flares of ships marked the trading post. If she started out in fair weather, certain which peak she had to climb, she might reach the post, the one footprint of civilization on the planet.

As dull as Ende's sun was, compared to the radiant solar star of Linna's home, the light nonetheless cheered her. The day's temporary warmth relaxed her. Her intractable headache had finally gone away. Linna felt almost confident. Today, she would watch for opportunity.

Iste spread out a net made out of string, the brown fiber of a weed that grew in the deep lake. The edge of the net secured the fiber ends in elaborate knots. In one place, the net's knotted rim was torn from a struggle with a monstrous dish-scaled fish. Iste pointed. "Make it back."

"I don't know how."

"You forget too much," he said dourly. Then he showed her how. Apart from chiding his forgetful ghost, he was patient with her fumbling fingers, demonstrating how to mend the net's border with the complicated knots that would not slip when wet.

Iste was not an old man. His tawny skin was sleek, his hands nimble in making and repairing things. He had never hurt Linna. Iste was a good man by the mores of a culture poised on the knife edge of survival, where a man had to have a wife to survive. His delusion about Linna had wrapped itself firmly around a core of realism: a man alone was an impossibility.

Ende was a terrible place for a human colony. This region, the equatorial and most habitable part of Ende, remained largely desolate even after two thousand years of settlement.

"Gotta shit," said Iste bluntly. He disappeared toward the area dedicated to excrement and fish waste, in a deep little hollow, well removed from the hovel.

Linna snatched up a long coil of lakeweed fiber. Shaking with sudden determination, she knelt beside the stone that lidded her cache and scanned the landscape for any omen that this might be the wrong time for her flight.

To her astonishment, Linna saw two figures in the distance, natives making their way uphill from the lake, apparently headed directly toward Iste's camp. Linna froze. Now what? Hope these two could talk sense into Iste, or run away from all three of them?

If she ran, she would be as visible to the visitors as they were to her now. She remembered what she'd intended right after the wreck, before Iste, with his impenetrable craziness, found her: locate some natives and ask for help.

When Iste returned, he stood waiting.

One of the two visitors was a man, the other—smaller, with a skirt dyed purple over Endish leggings, and a cape decorated with embroidery and shiny fish scales—a woman. Linna had an impulse to rush to them and beg for help. She restrained herself. Native women didn't talk before being spoken to. Outworld women were advised to do likewise should they need the cooperation of the natives.

The visitors stopped a few feet away and stood as still as Iste. "*Ache, Iste,*" said the man.

Linna's lingchip, the device implanted in her brain to interpret language, promptly activated. She'd obtained an Endish patch at the trading post. *Ache,* according to the chip, was the native word for hello and goodbye.

Iste had never spoken to Linna in his own language. He insistently used trade pidgin even when she coaxed him to do otherwise. Finally she'd recalled from the notes in her lost notebook that be-

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reaved spouses on Ende were supposed to stay silent for a full Endish year. Maybe trade pidgin didn't qualify as real speech, allowing a bending of the rule.

The male visitor regarded Linna, then turned his whole body toward Iste. "What woman is that?"

The visitor had used Endish, but Iste was sticking to pidgin. "My woman. Your sister."

The visitor's eyes went wide and his woman companion gasped audibly.

This was Iste's dead wife's brother. Linna bit her lip, making herself wait for the right time to speak to him.

Iste's brother-in-law asked, "Did she show up an eightnight ago?"

Iste grunted. Minimal affirmative.

"Well, a trader rep came to our village yesterday. He said a woman Outworlder came to Ende and got lost. He was asking people if they knew anything about it. Look, Iste, this is that woman."

Relief made Linna almost woozy. This man was perfectly sane. And somebody from the trading post was searching for her.

"No, Okarde. No." The chip didn't supply a translation for "Okarde": it must have been a personal name. Iste gestured as if cutting something with the edge of his hand. The helpful chip was audiovisual, attuned to the gestural as well as verbal parts of language; Linna abruptly understood Iste to be signaling vehement disagreement. "See color clothes? My woman make good color clothes."

Linna's rented cold-coverall was blue with yellow tunic, brighter shades than any of the native dyes.

Okarde nodded. The chip apprised Linna that a nod on Ende meant *no*. Okarde went on, "She's wearing trader clothes. Get her back to the traders or we'll all be in trouble."

Iste nodded energetically. *NO!*

"Listen, Iste, your woman could not come back. You never sent the bright wing for her."

Linna had read about an Endish funeral rite called the Bright Wing Ceremony, in which the natives called back the spirits of the dead by flying a kite, a fragile, temporary link between their bitter land and its citadel-heaven in the sky. The rite had fallen into disuse since the establishment of the trading post.

"Bunkum," said Iste, using trade slang for inferior goods. It jolted Linna that even Iste, too proud to work in the beryllium mines for the traders, still using dishes made from the scales of the monster fish he hunted, doubted his people's old ways. For cultural precepts he had substituted personal delusion. "She come back anyway."

"Listen, listen, Iste. My mother's father came back. He was a red-bear. My clan remembers."

Okarde sounded patient enough to reason with Iste, whose reason had been mangled by grief. Surely Iste would have a change of heart. Linna seized at that hope. She didn't hate Iste. She didn't want him to be completely shattered by the truth—or to turn violent, either.

Okarde went on, "Sometimes dead people come back as birds. Fur-weasels maybe. Even darkfish. But not people."

Iste snapped, "Ghost look like people."

"Ghost?" Okarde echoed. Making circling motions with his hands, he gestured futility. Iste was as impervious to Okarde's reasoning as he had been to eight days of Linna's. "Men have argued enough," said Okarde. "Yayu." With his knuckle, he gestured toward the woman who'd been silent up to now, probably his wife.

Yayu looked sadly at Iste. "She's not your woman. You know that."

Iste nodded, *no, no, NO*. He curled his gloved hands like tightening springs, like a cornered man.

"You say." Okarde pointed to Linna with his knuckle.

Linna wanted to blurt: I am an outsider! Take me away from him, away from here! But something made her swallow the words with an audible gulp.

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Her mind raced.

Teetering on the brink of craziness, Iste was a good man with missing linkages in his mind. As an archaeologist, Linna had been trained to think like the mute ruins. Look for the fourth wall, the center hearth. Dig where they might have been. Was Iste missing his people's spirit-ceremony? Could that set him right, make him let her go voluntarily?

But why did that seem so utterly important?

The natives waited. They had hardly moved during the whole exchange. Their world did not reward wasted motion.

Linna shoved her confusion aside to sort out later. She knew what she wanted to make happen, if not why or whether it would succeed. She still held the coil of fiber she'd meant to steal. What other kite string could they use? With the coil, she gestured toward the sky. "It's not good for Iste without sending up the bright wing."

Okarde blinked. Then he grunted. *Yes.*

Okarde's wife said, "Yes. Yes." She gestured with her fingers, weaving them together to mean collective agreement.

Iste shrugged. The lingchip made no comment. The shrug must have been a foreign gesture that came from the trading post together with the pidgin and trade goods that had irradiated Iste's world.

In pidgin, Okarde said, "Good. Iste and Yayu make the bright wing right. I go bring *tugapu*."

Tu, "she" plus gape, "man," literally, "she-man," the chip told Linna. It was the Endish word for shaman.

Iste seemed distracted. Forced closer to reality, he was visibly pressured. Linna felt anxious about him and exasperated with herself for feeling that way.

The woman, Yayu, looked older than Iste, with wrinkled skin and graying hair. Either age or some less obvious social factor gave Yayu the authority to direct Iste in the making of his kite. She sent him to his cache for long thin fish bones and a wide sheet of fish skin thin as parchment, along with a skein of lakeweed fiber. He framed the kite with three bones, tied together at one end, fanned at the other, with a fourth bone tied across the frame. Yayu approved the frame. Iste then sewed a triangle of fish skin onto the bones. The resulting kite was broad as Iste's height.

A wind picked up, blowing clouds across the sky and cold air off the lake. The kite briefly slipped away from Iste's hand and skipped across the ground, eager to fly. Watching Iste catch it, Linna felt a muddled mix of pity and curiosity.

Yayu had Linna inspect Iste's skein of lakeweed for weak fibers. Yayu herself cut out weak sections and made small, clever knots to tie the lakeweed into one thin, long kite string.

Ende's weak sun teetered on the zenith of the sky and slipped off, sliding down. Shortly thereafter, Okarde returned with a new stranger who rode a shaggy brown pony.

Yayu and Iste rose to stand waiting. So did Linna.

The shaman wore the clothes of a woman, with a skirt of dyed cloth and a cape decorated with embroidery and tiny diamonds like frost. But the shaman was taller than Iste or Okarde. The age-rough voice that called, "*Ache!*" was male.

He dismounted from the pony with the stilted grace of an older woman. The shaman's strong-boned face, though, with wisps of white hair showing around the hood of his cape, was that of an old man. Linna recognized an ancient pattern, ages older than civilization, a primeval human solution to discrepancy of sex role and temperament. The individual had a stark choice in life: to live as man or woman. The few who chose a role opposite from their sex, and showed skill at it, were holy people, visionaries or leaders.

The cross-dressing shaman regarded

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Linna with copper-colored eyes.

"See, Tugapu?" said Okarde.

"My woman, Tugapu," said Iste, sounding almost pleading.

Tugapu said, "I see sky-eyed woman, and bright wing ready, and clouds on the wind. Good." Tugapu turned his pony loose to graze on the sparse ground. Then he ceremoniously counted those present, including Linna and himself. "A hand of person. Enough to make bright-wing work. You talk Ende?" he asked Linna.

Linna hadn't had enough money to buy a full two-way Endish program for her lingchip. "I can't speak your language, but I understand it."

He replied in Endish. His utterance struck sparks of meaning from the chip, like an iron blade up against a spinning whetstone. "And I understand yours somewhat. Good." The shaman turned half around and raised both hands toward the sky. "Ah, behold, friends and foreigner, here is a man alone, this man Iste. Where are the dead? Since our ancestors came across the stars from the Womb World to live here, there are so many generations that the top three hands of this ground is People."

The shaman faced toward the mountains, the starship-touched heights with rock walls scribbled all across their nearer foothills. Linna's attention sharpened as she listened. The litany had embedded in it some relic knowledge of the Colonization from Earth. Maybe here was what she'd sought in the first place, ruins of the early colonial days: ruins of memory more well organized and informative than the ubiquitous rotten walls. Linna listened with the same intent curiosity with which she'd first seen the walls.

"Will the ground speak softly at night in the hogan, or make fire for this man, or spread hodos on the ground to dry so that he has food for the winter? The Endish ground brings no *** to Iste. How can a bereaved man have ***?"

Attempting to translate Tugapu's word, the lingchip generated several alternatives.

Futurition

Help

Hope, the lingchip decided.

Linna thought she understood. On Ende, a man alone was an impossibility; help was hope was the only chance to have a future. The language embodied the inescapable logic of life here.

"Hear me—a People came before us People. In this is hope. A People arose after the stars vomited out dust and iron that formed into round worlds, but long before our ancestors came out of the Womb World. The Before People came of age long ago and learned to shape the mountains and the waters of worlds just like a potter shapes clay, hear me!"

Linna stifled a yelp of surprise. The shaman had just paraphrased the most mystifying archaeological puzzle of all time.

Traces of an ancient, alien interstellar civilization had been found in the stars. The relics were as cryptic as they were widely scattered. The unknown makers had been tagged Dawn Builders by the few controversial archeologists attempting to understand the incomprehensible artifacts.

But how had the idea made its way to this remotest end of starflight? The trading post wouldn't disseminate ideas about Dawn Builders along with their trinkets and tin dippers.

"They left here a waymarker for the ones who would come after. It wasn't just a heap of stones for birds to nest on and lichen to creep into the cracks, but one that only people can see, only with the eyes of their minds. Stone heaps fall down. The Before People's waymarker lasts forever."

Linna felt dizzy with changed expectations. Could the shaman possibly mean what he said, or even know what he was talking about? Dawn-builder artifacts had been claimed on a dozen colonial worlds. Such claims seemed irrefutable in perhaps four instances. But

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the technological principles underlying the artifacts had so far been a riddle without an answer. One otherwise reputable team of archaeologists had ventured that the alien technology might be psychic, depending on some still poorly understood synergy between mind and specific kinds of matter.

"Here in the center of the world rise the mountains they made to be a travois carrying their sign through the ages."

The Endish Range was an orographic oddity—a range of mountains arrayed in a tidy v-shape for no identifiable geological reason. Geologists had relegated it to the ranks of relatively minor planetological puzzles. Meanwhile and elsewhere, archaeologists argued about whether Dawn Builder "artifacts" included geological details on several worlds, dubious features blurred by continental drift.

But Ende was so old that it was very geologically stable. What the Dawnbuilders had made would stay that way. For untold eons. Linna found herself nodding eagerly.

Tugapu stared at her. "You disagree, sky-eyed woman?"

"I'm sorry, when I nod, it means I agree. The things you say are true."

"*Spisi,*" said Iste. *Fish-shit.*

"No!" Linna insisted. "A dozen worlds have traces of the Dawn B- Before People. I studied this a little." It had been peripheral to her studies in human archaeo-history, but unforgettable as a weird and vivid dream.

"Ah," said the shaman, fixing her with those compelling copper eyes. "*Tekirte.*"

Literally, he said *he-woman,* the lingchip explained in her brain. The word denoted the female counterpart of shaman: a visionary woman chieftain.

All three of the other natives regarded her with surprise on their faces.

With a single verbal stroke, the shaman had redistributed the balance of power in this group, handing Linna a measure of authority. She guessed that she now had permission to speak out of woman's turn. But she had to be diplomatic. Or she'd lose her new credibility. She took a deep breath. "Please go on."

"My friends and foreigner, in lining-up time we can make the Before People's hinges in the sky turn, by sending up a bright wing and hunting it with our attention. Why?"

Linna sensed Tugapu posing a test of her knowledge. She had the answer he wanted. She could not possibly render it into trade-pidgin, though, at least not before they all grew weary of the clumsy attempt, so she plunged ahead in Panglish, hoping he understood well enough to get the gist of it. "Some smart thinkers who study the Before People's handiwork say it's psychic engineering. Minds make it work. Focused mental attention makes something happen. There are a couple of places where the psychic technology may be powered, maybe, by the orbital symmetries, ah, by a world and small moons moving in a harmonious way is what gives it power."

What about a world and two suns? What could a Dawn-artifact do if it were powered by a double star? She took a breath to steady herself. "But there's one thing more thing proposed as intrinsic to their devices, ah, important to make things work. Crystallized carbon—diamond—somehow is a catalyst. Icestone is what I mean," she added, recalling the trade-pidgin word. "It needs icestone to start what happens."

A pidgin word existed because high-grade diamonds occurred in these mountains, not in rich veins easy to mine, only in glistening rare bits found by natives on rare occasions. The traders at the post paid bounties for diamond.

The shaman interlaced his fingers, the gesture of total agreement. The diamonds embedded in the embroidery of his cape sparkled like fresh drops of dew. "True."

Iste looked confused, like a man clinging to an overturned boat in rough water. "True?"

"It's truth," said Linna, emphatically.

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This was the first thing about Ende that had made archaeo-historical sense. Linna was as intent on the shaman's story as a fish-hunter who caught a glimpse of a great fish in the deep water.

The shaman took a large lustrous stone from a pocket under his cloak. "Some people will sell their living or their dead for trader money. They use glass in the Bright-Wing ceremony instead of diamond. You can get big pieces of glass from the traders cheap, very pretty. It doesn't work, though." He affixed his diamond to Iste's kite.

Placing both hands on Iste's shoulder, Tugapu explained how Iste should give the kite into the arms of the wind when the time came. Iste seemed numb and slow to understand. The shaman was patient. He'd dealt with the bereaved many times before.

"Go to your brook and pray until sunset," Tugapu finally instructed Iste. Iste obediently walked away. Okarde trailed after him, vigilant in case the red-bear returned to threaten the solitary, preoccupied man.

Tugapu sat in the lee of the wall near Iste's hovel. With a gesture he invited the women to rest likewise.

Yayu said, "I hope his real wife comes back today. Then he won't mind when we take Sky-Eyed Woman to the trading post."

"Yes. That will prevent discord," Tugapu replied. He turned to Linna. "It's the Endish way. You did well."

For primitive peoples in the harshest environments, social discord was the evil of all evils. Had Linna absorbed some of that attitude from Iste, and was that why she had suggested this instead of immediate salvation?

Or had she simply submitted to her captor, let him force her to be willing to play the role of devoted ghost?

On impulse, Linna asked Tugapu, "Do you really believe in ghosts? Before I came here, I learned all I could about Ende, what Outworld visitors had said. There wasn't any mention of ghosts."

"I heard something very interesting today. The trader who came to our villages asking about a lost outsider said she is a young woman, from a new place, but she has old learning."

Surprised, Linna chose her words with care. "I studied on Earth—the Womb World. That's where all the old learning is best kept now. I've learned all I could about ancient history before our ancestors left Earth. The place where I was born is new, though." New Catalunya was a post-Colonial world, discovered on the wings of fast starflight, a thousand years after Tugapu's ancestors settled on Ende. No locale on New Catalunya could be said to have topsoil of which the top fraction consisted of molecules that had once been living humans. The dead of New Catalunya were an imperceptible trace of atoms in land and sea and wind. Beyond whimsical campground stones, could that have been what attracted her to archaeo-history—a need to connect with a deeper human past?

"I thought all Outworld people lived in new worlds, and always looked for new places with new things to buy and sell, and thought about nothing but tomorrow."

"That describes civilization all too well," she admitted.

"Here it was like a man in a hurry stepping on a thin-frozen puddle," the old shaman said quietly. "The ice cracks and gets smeared with ugly mud. The man will go on his way. Hurrying—somewhere. I think his face is turned away from his own home."

"Some thinkers say it's a need—an insatiable hunger—to find another intelligent race," Linna said. "We've never found anyone else."

"Hmmm. Anyway, that man doesn't think twice about the ice he stepped on." Tugapu, in his adult life, had seen his culture craze like ice under the impact of the trading post bringing mercenary outsiders and trade goods, taking

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away diamonds and beryllium. "There are no ghosts on Ende. Memories of our dead return to us as animals and plants in warmtime. Not as somebody's shadow walking around by itself! Ghosts are a trader idea. I don't believe in them."

Daylight shaded into a fainter but pinker illumination from the setting sun. Thick clouds, higher than the morning's pall, rode on a rising wind. With a piercing whistle, Tugapu summoned Iste and Okarde back.

"Tugapu--" Linna hesitated, remembering Iste's blunt impatience at too many questions. Had that been his craziness, his Endishness, or just Iste? "Do you believe in Heaven?"

"What?"

"The place where people go when they die. What Cloud Sky City is."

"Ah! You mean *****."

The lingchip offered a flurry of alternate translations for Tugapu's word.

end + beginning
memory
remembrance
communion
Endbeginning.

The lingchip's efforts made Linna's mind reverberate like a tapped bell. Evidently, whoever had translated the Endish word as "heaven" had used a short cut for an untranslatable religious concept.

The brothers-in-law returned. Iste took up the kite, holding it poised over his head, while Tugapu held the string. The kite quivered as Iste shook with feeling trapped inside himself.

Tugapu gave a brief shout. Iste tossed the kite up and Tugapu stepped sharply back, keeping tension on the string. Filling with wind, the fish-skin parchment fluttered. The kite angled up into the sky, taking its glistening burden of diamond.

Tugapu pumped the kite string, chanting. His voice shaped the same phonemes as before, but these were not Endish words. The chip disregarded his utterance. The chanting had an almost hypnotic effect, welding Linna's attention to the kite dodging higher into the sky.

The invisible red star pulled Ende toward its primary sun. With incipient warming came atmospheric turbulence. A strong flow of wind carried clouds into the V-shaped Endish Range. Clouds had amassed between the mountains, with thick gray hearts and sunset-tinged pink fringes. Linna thought she saw a faint pulse of lightning. The points of the kite sparkled.

Linna's attention wavered as she realized that the kite string might be damp, the lakeweed fiber might have metallic content, and the kite might draw lightning down on all of them.

"Watch the kite! Our minds must be in accord!" Tugapu hissed.

The old shaman knew what he was doing. Linna returned her gaze and attention to the kite. High in its ascent, it slipped inside the grayness of clotted cloud. Lightning flared inside the clouds.

Linna felt a sudden conviction of combined effort, like being part of a team game. But this was mental, and as precise as turning a key in a lock. The hair on the nape of her neck stood up.

The cloud lit up again. This time it stayed illuminated. There was a bubble in the clouds, an area empty of cloud but full of shapes outlined in clear pale light. Linna gasped.

Crisp edges and sharp angles contained smaller and even more complicated shapes, an infinite and compelling geometry. And it moved, meshing and rotating, continual change with standing waves of geometric form.

The vast structure appeared to be made of light and air, ethereal as a mirage. But it had enough solidity to divert the wind, making the blowing clouds eddy.

It hovered before the rough, dull backdrop of the Endish Range. Its brilliant complexity announced alien intelligence from the dawn of time.

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Linna would have watched, mesmerized, if it had remained for a night or a year. But the geometric vision vanished like a soap bubble. Cloud poured into the place where it had been.

Okarde and Yayu looked at each other in mute amazement. Shaken, Linna sat on the ground. Now she knew why the Endish, with their dim legends of civilization, called it City. It reminded her of Earth's ancient urban cathedrals. But the most elaborate temple on Earth had been a primitive dusty toy compared to Cloud Sky City.

Her cheeks felt wet and chilled. She had been moved to tears by Cloud Sky City.

Ende breathed its own awe. A breeze coursed over the land, startlingly warm and moist, the earliest trace of Ende's spring.

Tugapu brought the kite fluttering and rattling to the ground. The air seemed clear as glass, all the way to the distant walls trailing over the low slopes of the Endish Range like aimless sketched lines.

Chirping broke the soft silence. A bird perched in the stunted tree that grew beside the wall. Illuminated by the setting sun, its feathers glowed soft blue and yellow, the plumage of spring.

"Iste!" Tugapu pointed at the bird. "See her!"

Iste stared at the bird. Then tears trickled from his eyes, frozen grief beginning to melt like winter's ice touched by the spring.

It was just a bird. A coincidence. This was spring, and time for birds to have their brief breeding plumage, and for red-bears and other creatures to migrate.

But if Iste believed that his wife had come back to him he would not have to be a man alone any more, a crazy driven man, doomed. He could live again and find another mate. Alone, his only hope had been believing in a ghost.

He looked at Linna. Their eyes met. His were wide, brown, vulnerable.

"*Ache,* Iste," Linna told him. Hello and farewell.

Okarde led the way up the mountain trail. The nighttime cold of Ende pressed around Linna, only staved off by exertion. Okarde said he knew the trail like the inside of his own kayak. Linna believed him. But she had been desperate for so long—and right now the elation of seeing Cloud Sky City was so buried by how cold and tired she was—that she half-expected more dismay.

Yayu had stayed with Iste to wash his face and feed him a meal, fulfilling the ceremony. But Tugapu rode his shaggy pony. He coaxed it close to Linna, and she felt its hot breath on her neck. "What will you tell the traders?" Tugapu asked her.

"Nothing about Cloud Sky City," she said emphatically.

"I hoped you'd feel that way," said the old shaman.

"I won't mention the Bright Wing ceremony, or your diamond, either. And they won't wonder about what I don't tell them. Traders expect archaeologists to go off looking for something that isn't there and not find anything profitable."

"Did you find what you were looking for?"

Linna had been thinking about this all the way up the mountain. She might, after all, have found something to justify the prize she'd been given by the University. But only if she made what she had seen all too public. Scholars and scientists ferreting after the mechanism of Cloud Sky City would be no better than traders and prospectors after minerals. Finally she answered, "No. I didn't know the Before People had been here. I was looking for buildings from the old days when our ancestors first struggled to the stars."

"It's easier now," Tugapu said. "People glide across the stars as easily as fish-hunters in kayaks cross the lake."

The night was clear, the sky strewn with stars like the diamond-sprinkled embroidery on Tugapu's cloak. Star

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flight should have been the fulfillment of twelve thousand years of civilization. But it hadn't worked that way. Not all the rediscovered Colonial worlds nor even all the stars in the galaxy were enough. "I think fish-hunters get what they need and go home happy," Linna panted.

Okarde, gesturing toward the crest of the mountain, interrupted. "Top part too hard for talk." People and pony labored up the steep trail in silence. Tugapu soon dismounted to spare the pony. It was slow torture to keep climbing at Okarde's steady pace, with the cold intensifying, tearing at Linna's lungs like a dull knife. Her legs felt like lead weights and her toes ached.

From Iste's camp to trading post was not a great journey for natives who knew the way. Alone, though, she would not have made it this far. Help is hope.

Okarde signaled stop for a brief rest. As she wheezed, Linna could dimly see the whole mountainside, spreading out and down to the distant lake barely visible as a sheen of reflected starlight. The scene looked familiar. She'd seen this land from the same perspective once before. It had been effortless then, gliding out in the landflyer.

The ragged old walls lay under the darkness, semi-circled around empty land.

Or semi-circled around empty air.

Linna's mind lurched in sudden realization. What if not just a handful of people, like today, but thousands had all focused attentive minds on a diamond high in the sky? Cloud Sky City would have appeared to all of them, right there: where the walls silently proclaimed that something important should be.

Linna's heart raced with the thrill of understanding. Ende had been a pilgrimage site. That was why the walls were so extensive and disorganized. People numbering in thousands had camped on the mountains' skirts, building rock walls to break the wind and separate one group's small ground from another's. They'd lived in temporary structures long since obliterated by time. The pilgrims had come across the stars the hard way, in dangerous stasis that lasted for empty centuries, not to build a city, but to marvel at the apparition in the sky.

She almost tripped in distraction. End is beginning, and memory is heaven. "Tugapu—" she gasped, "Does Heaven—I mean Endbeginning—mean there's hope? For people who have died or for people who live now?"

"Ah. Both." He was pausing for breath, but walking steadily up the steep trail. "The Before People knew that."

The monument of the Dawn Builders meant something infinitely greater than Iste's wife or Linna's survey. But the devastating limitations of slow starflight had strangled the wonder of Ende before civilization even knew what it had missed.

The empty hole in the heart of civilization hadn't changed since then, but everything else was different now.

A star fell out of the sky. It blazed brighter, until it touched the top of a mountain, a landing starship backlighting the blocky shapes of the trading post in front of the landing field. Yesterday it might have left a world ten stars away.

The trail abruptly leveled. Tugapu reined in his wheezing pony. The landing ship's flare illuminated his somber, aged face as he looked directly at the boot slowly shattering his people's existence. "We'll go home now. You can see your way."

Linna blurted, "Yes. I can. The Outworld is like Iste. Alone and sad and crazy. It needs to see Cloud Sky City!"

Instantly the shaman fixed her with piercingly intent eyes. "How?"

Linna felt a lump in her throat. She could imagine the terrible possibilities that might spring to Tugapu's mind: traders—or scientists—stripping Cloud Sky City's secrets out of the mountains like beryllium ore. "To do any good, it would have to be the way we did today.

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With minds working together. Just watching to see. I don't know that can happen. But it happened once, almost. I'll have to study more old learning to find out more about that time." Buried in the rubble of the cataclysmic history of Earth just before the Star Age, there must be some clues about the pilgrimage—references to the Eden that ships left Earth not to create or own but just to see. Her mind flew back across the stars to Ende. "If I came back here, could you tell me the old stories of Ende?" she ventured. "Teach me about Ende?"

He answered indirectly. "What about those smart people who see other things the Before People made, and try to figure out how they work?"

Some of the Dawn Builder Hypothesis archaeologists were as egotistical as they were brilliant. At least one, by all accounts, was a different and better sort. "There's one man who studies the Dawn Builders, who has the reputation of—looking before he steps on ice and breaks it. I think I need to talk to him—but not others. Not now. Cloud Sky City isn't like a mountain to mine for beryllium. I understand that now."

Tugapu smiled. It was the rarest of Endish gestures. "It's good you're so young. You'll need a long life to accomplish everything. My own road ahead is short now, so come back soon."

Linna felt her whole life pivoting like a compass needle, swinging toward Cloud Sky City. In a daze of changed reality, she thanked Okarde for bringing her to the trading post. In reply, he held out his hands palm up—gesturing respect, the lingchip told her.

Then Tugapu held up a hand in benediction. "*Ache, Tekirte.*"

With startled wonder, Linna recalled that shamans like Tugapu might never have children. Sometimes, instead, they chose successors.□

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The "Rare Earth" Hypothesis

Many works of science fiction, for example those of David Brin, Larry Niven, and Poul Anderson, assume that our galaxy is populated by many intelligent alien species that we will eventually contact for cooperation, competition, or perhaps combat. Isaac Asimov, on the other hand, assumed in his Foundation Series that humanity would spread out into the empty galaxy and colonize it without encountering other intelligent species.

Rare Earth, a science book written by two of my University of Washington colleagues, geologist Peter Ward and astronomer Don Brownlee (W&B) depicts our galaxy as a lonely place dotted with hostile lifeless planets orbiting stars that are mostly too hot, too cold, too unstable, or too short-lived to sustain the development of complex life. W&B argue that while bacterial life may be very common in the universe, complex multi-cellular and animal life-forms must be rare, and intelligent life very rare indeed. This column is not a book review. Instead, I want to summarize the ideas of Ward and Brownlee and what they call the ***Rare Earth Hypothesis.***

In the 1970s astronomers Frank Drake and Carl Sagan devised a method, now called the Drake Equation, for estimating the number of advanced civilizations that might be present in our galaxy. In 1974, Sagan used the method to estimate that a million advanced civilizations might exist in the Milky Way galaxy alone. However, many discoveries in both astronomy and geology have been made since Sagan made that estimate, and these lead to a more pessimistic conclusion.

As Goldilocks learned in the house of the Three Bears, it's very important that conditions are not too far toward either extreme, but "just right". W&B argue that for the origins of complex life, these *just right* conditions are rare. They provide a long list of situations peculiar to the Earth that make it suitable for the evolution of higher life-forms. Near the end of their book they present a revision of the Drake equation, a chain of probabilities that they call the ***Rare Earth Equation.*** It gives N, the number of Earth-like planets having complex life forms, as:

$$N = N^* \times f_p \times f_{pm} \times n_e \times n_g \times f_i \times f_c \times f_l \times f_m \times f_j \times f_{me}$$

Here N^* is the number of stars in the Milky Way galaxy, f_p is the fraction of stars with planets, f_{pm} is the fraction of planets that are metal-rich, n_e is the average number of planets in the star's habitable zone, n_g is the number of stars in the galactic habitable zone, f_i is the fraction of habitable planets where life does arise, f_c is the fraction of planets where complex metazoans arise, f_l is the fraction of the total lifetime of the planet that is marked by the presence of complex metazoans, f_m is the fraction of planets with a large moon, f_j is the fraction of solar systems with Jupiter-size planets, and f_{me} is the fraction of planets with a critically low number of extinc-

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tion events. In the rest of this column, I want to discuss the terms in this Rare Earth equation one by one, and then discuss some of the other factors not in the equation that may turn out to be important.

N*(stars)—Estimating the number of stars in the Milky Way galaxy is tricky, because we don't know our galaxy's mass very well, and there is little information about the population of very small stars. N* is roughly 500 billion stars of all classes.

f_p (planets)—In 1995 astronomers discovered the first planets orbiting other stars. Since then more and more planets have been discovered. However, it is not clear what fraction of the stars in the galaxy actually have sizable planets.

f_{pm} (metal)—One interesting correlation stands out among the existing observations of extrasolar planets. All of the observed planets orbit metal-rich stars. This suggests that planets, or at least planets large enough to have been observed so far, may not be all that common and may be peculiar to the subset of stars that are rich in metals.

n_e (habitable zone) —The orbit of Earth happens to be "just right", falling in a narrow habitable zone of orbit distances in which a planet not only has liquid water now, but also had liquid water several billion years ago when the Sun was cooler and life first formed. W&B mention a 1993 estimate indicating that if Earth's orbit was 5% smaller or 15% larger it would not be in this habitable zone. This zone shrinks for more massive stars because of their more rapid evolution and for less massive stars because the zone of liquid water itself is narrower. Thus the average number of planets in habitable zones, averaged over all stars in the galaxy may be very small indeed.

n_g (galactic zone)— The Solar System is about 25,000 light years from the galactic center, roughly a third of the distance from the center to the outside edge. This position is fortunate. Stars too close in have too may close neighbors that disturb the system's orbits, too much fireworks from neighboring supernovas, and too much radiation that comes from the galactic center. Stars too far out are too deficient in the heavy elements cooked up in supernovas near the galactic center.

f_l (life)—W&B suggest that the fraction of habitable planets where life does arise, at least in the form of bacteria, may be large. Geological evidence suggests that bacteria were present on the Earth as early as planetary conditions made it possible for them to exist. This view is also supported by observation of living bacteria from rock extracted from very deep wells and mines. The controversial claim that bacteria fossils may have been observed in meteorites of Martian origin found in the Antarctic, if true, also supports this idea.

f_c (complex metazoans) —W&B argue that the fraction of planets with bacterial life where complex metazoans arise may be very small. They base this view on the observation that for four-fifths of the time since life first appeared on the Earth, some 2.5 billion years ago, there was only bacterial life. They also point out that the Cambrian Explosion, when complex metazoans first appeared, was preceded by some extraordinary climactic and geological events that may have triggered it.

f_i (planet lifetime)— Even if complex metazoans arise, their development, as indicated above, may take a long time. Finding complex life on another planet depends on the size of this time window.

f_m° (large moon) —Except for the Earth's moon, the satellites of the Solar System have only a tiny fraction of the mass of their primary. Mercury and Venus have no satellites at all. The moons of Mars, Phobos and Deimos, are small rocks with masses of only 27 and 5 billionths of the mass of Mars. Even the rather large moons of Jupiter and Saturn have masses of only a few parts in 10^5 of

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their planet's mass. Our Moon, on the other hand, has 1.2% of Earth's mass. This raises the question of how Earth could have acquired such a large satellite. The prevailing explanation is that a random collision occurred between the just-forming Earth and a Mars-size object, with Earth capturing most of the mass from that collision while about 1% of the debris coalesced into our Moon. Such an event is very unlikely, which suggests that most Earth-size planets will not have moons with anything approaching 1% of the planet's mass.

An important consequence of our giant Moon is that it stabilizes the 23° tilt of the Earth's rotational axis with respect to its orbital plane. Geological evidence indicates that over many millions of years the tilt of the Earth's axis has stayed within a few degrees of its present value. Recent calculations have shown that without the Moon, the gravitational effects of Jupiter and the Sun would have caused the Earth's tilt to wander chaotically over a wide range, producing enormous changes in climate and a hostile environment for the development of complex life.

f_j (Jupiter)—W&B argue that if Jupiter (300 times more massive than Earth) were removed from the Solar System, the frequency of comet and asteroid impacts on the Earth would increase by a factor of about 10,000. A major asteroid strike capable of significant extinction of species is estimated to occur in an average time interval of about 100 million years. If Jupiter were not present or was in a significantly different orbit, this interval might increase to one strike every 10,000 years, impeding the development of complex life.

f_{me} (extinctions) —Since the evolution of bacterial life on Earth some 2.5 billion years ago, there have been no extinction events large enough to sterilize the planet. W&B argue that this critically low number of extinction events may be unusual. The fossil record shows that there have been some very severe events, the most recent of which was the asteroid strike 65 million years ago that killed the dinosaurs as well as much of the life in the oceans. W&B argue that a very stable planetary system is required, with nearly circular orbits for all of the outer planets, for this condition to exist. An accident such as the gravitational perturbation of a passing star could easily destroy this delicate stability.

In addition to the factors in their Rare Earth equation, W&B mention other factors peculiar to Earth that may have affected the development of complex life. Here is a partial list.

Mars: W&B argue that the fossil record shows that the cooling Earth developed bacterial life as soon as conditions permitted. They suggest that this may be because the bacteria first developed on Mars, which cooled earlier, and that perhaps Earth was then seeded with these bacteria carried by meteorites reaching Earth after having been ejected from Mars by asteroid impacts. The low gravity of Mars makes this more likely, and it is estimated that 10% of meteors ejected from Mars may impact Earth. A system lacking a Mars-like planetary companion might have been slower to develop bacterial life.

Snowball Earth:: Recent evidence from geology indicates that twice in the Earth's history the planet became very cold and ice covered, even near the equator. The first of these Snowball Earth eras occurred 2.5 billion years ago and the second about 550 million years ago. The timing of these eras seems significant. Although bacteria first appeared on Earth about 3.8 billion years ago, there was a dramatic change in the single-cell life in the Earth's oceans about 2.5 billion years ago. Organisms of the domains Archaea and Eucarya first appeaared then, and it is the Eucarya from which all animal life is decended. The Cambrian Explosion, when complex multicellular creatures ap-

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peared on the planet, occurred about 550 million years ago. Thus, two key events in the evolution of animal life on Earth seem to have each followed a Snowball Earth era of planetary deep-freeze.

Plate Tectonics: The Earth is hot inside because of the decay of radioactive isotopes, primarily potassium-40, in its interior. This heating drives plate tectonics, the upwelling of material from ocean rifts, its subduction at the edges of continents, and the drifting of continents. It has recently been realized that this action has a moderating influence on temperature excursions in the Earth's climate. When the temperature rises too high, plate tectonics cause the capture of carbon dioxide into rocks, reducing the greenhouse effect and producing cooling. When the temperature falls, the opposite happens and less carbon dioxide goes into rocks, producing warming. A planet without plate tectonics would lack this temperature regulation mechanism. Without a stable temperature, the evolution of complex life becomes more unlikely.

The conclusion of W&B, which I have only been able to sketch here, is that Earth is a rare place where many random factors have conspired to create a nearly ideal site for the evolution of complex life. Putting plausible numerical estimates into the Rare Earth equation (not done in the book) suggests that there are only a few planets with complex life per galaxy. Thus, it's possible that Earth is the only planet in our galaxy with intelligent life.

Should SF writers therefore stop writing stories with intelligent aliens? Of course not! Ward and Brownlee may have missed some factor that makes complex life more likely. And in any case, the fictional examination of aliens teaches us much about ourselves.

AV Columns On-line: Electronic reprints of over 100 "The Alternate View" columns by John G. Cramer, previously published in ***Analog***, are available on-line at: *http://www.npl.washington.edu/av*.

Reference:

The Rare Earth Hypothesis:

Peter D. Ward and Donald Brownlee, *Rare Earth: Why Complex Life is Uncommon in the Universe*, (Copernicus, New York, 2000, ISBN: 0-387-98701-0)

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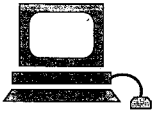

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JURISIMPRUDENCE

H. G. Stratmann

"My card, Emperor." Nero Claudius Caesar squinted at the stiff fragment of parchment the stranger handed him. Scintillating gold letters proclaimed "Ignatius Maximilian Wiley, J.D. Temporal Lawyer".

"What does this mean?"

Wiley ran his hand through slicked-back black hair, then rubbed a grease stain onto the sleeve of his $5,000 pinstriped suit. "It means, Emp, I've traveled from 2,000 years in the future to save your reputation. Hard to believe, but where and when I come from, nobody thinks you're a god anymore. Probably because of those slanderous rumors you murdered your mother and a couple of wives, and set Rome on fire."

Nero strummed an ethereally beautiful melody on his lyre, watching from his palace's balcony as towering flames licked the night sky in the distance. "Mom's death was an accident. She slipped on a grape peel during an orgy I held in her honor."

"Yeah, right. Won't take much to improve *that* alibi. Anyway, what I'll do is sue every history book publisher for libel. Make them retract those vicious lies about you. Maybe I'll demand their next editions depict you as the first incarnation of Elvis. Shouldn't be too hard, what with that guitar-thingy you play, and the way you're into serious babe-chasing and chowing down."

The lawyer opened a leather briefcase with platinum locks and extracted a thick sheaf of papers. "Testimonials from former clients. Genghis Khan, Vlad the Impaler, Ivan the Terrible—now textbooks call them 'freedom fighters.' Lucrezia Borgia and Lizzie Borden? Protofeminists. Torquemada and Rasputin? Up for canonization. This one with the 'X' at the bottom is signed by Attila the Hun. Hell, I made him seem like such a nice guy, his action figure was the best-selling toy of Christmas 2064!"

"Christmas?"

"Don't ask. You wouldn't believe it."

As the faint screams of the dying wafted towards the two men from the darkness, Nero artistically plucked a tender threnody for fallen Troy. "Those names mean nothing to me."

"Oops—guess they are a little ahead of your time. Actually, the rehabilitation job I'm proudest of *is* a guy you know. Name's Plato."

"The philosopher?"

"That's him."

"But my old tutor, Seneca, and other

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philosophers hold him in great honor!"

Wiley snickered. "So did lots of people until a year ago, when some 'classical studies' university professors with their own time machine discovered his dirty little secret. Seems Plato had it in for this wise guy Socrates after that smart-alecky geezer made him look stupid in front of his boyfriend. So when the old buzzard got in trouble with the law, Plato bribed the jury to convict him and give him the chair—with a cup of hemlock on it.

"Then this so-called philosopher spends the rest of his life making big bucks writing 'dialogues' about Soc and what a swell guy he was! But here's the juiciest part. All the time everybody's telling him how smart he is for coming up with these great ideas, Plato's cribbing from this humongous pile of lecture notes his victim left behind. Best of all, in his stories he has the 'Socrates' character claim *he* never wrote a thing!"

The lawyer shook his head. "You've got to admire a guy who can pull off a scam like that."

Nero tightened a string on his instrument. "But if your people know the truth now, how could you defend him?"

"Easy—when you know the system. You slap the professors with a lawsuit for defamation of character. Have the venue changed to Armpit, U.S.A. Before the trial, during *voir dire,* reject any prospective juror who knows the difference between Plato and Play-Doh. Then sweet-talk the jury, insinuate the profs are effete snobs, and confuse the judge with brilliantly clever legal maneuvers."

Wiley grinned like a satiated shark. "Those ivory-tower eggheads never knew what hit them. *They* just had the truth on their side. I had the *law.*"

He nodded toward the faraway conflagration. "Now take this little peccadillo. I'll deflect the blame from you to somebody else. Maybe I'll say a gladiator fell asleep while smoking in bed. Or some cow kicked over a lantern."

Nero frowned. "Christmas," he muttered. "There's a small cult with a name like that. They stand on street corners and hand out religious tracts saying the world will end soon. Perhaps I could blame them . . ."

His companion made a handwashing gesture. "Your idea, not mine! But *I'll* have to pick some other scapegoat. I'm a genius at bamboozling juries, but even I can't work miracles!"

"You really think you could make the people of your time consider me a noble, misunderstood hero?"

"I guarantee it, Emp—for a nominal retainer. Say, my weight in gold. A couple king-sized bags of diamonds, rubies, and emeralds. And a dozen of your cutest Vestal Virgins. I'm sure you can find the girls new jobs after I'm finished with them."

Wiley smirked. "The First Law of time travel is, 'You can't change the past.' *I* wrote the Second Law—'But you *can* rewrite history'!"

"Oh, I believe you, chariot chaser."

The lyre shrieked a teeth-grinding dissonant chord. Nero's face twisted into an expression that made Wiley shiver down to his shiny black wingtips. "But as my dear cousin, Caligula, used to say, some people *want* to be remembered as monsters."

The blazing noonday sun beat down mercilessly on the bloodsoaked sand of the arena. Wiley held his briefcase up to protect himself as a dozen lean and hungry-looking lions circled him, spurred on by thousands of jeering spectators. Nero waved cheerfully down at him from the Imperial seat, then clenched his fist and pointed his thumb toward the ground.

As Wiley glimpsed a lion's tonsils from close range, he found some consolation knowing the emperor would wind up as a gross underachiever. While history would remember him as only an average tyrant, with *his* talents Nero could've excelled in another profession.

He would've made a *great* lawyer.■

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EXECUTIVE COMMITTEE

Alan L. Lickiss

Some problems may be a *lot* older than we think!

Memorandum
From: Project Development Committee Chair
To: Executive Committee Department Representatives
Subject: General Design Approval

Congratulations to all! The customer has completed review of the general design documents from all of the departments. They have all been approved. Special kudos go out to the Biological, Insect Team. The customer was most impressed with the planned variety and quantity outlined in their document.

Detail design documents are due in one month to this committee. After that, we'll have one year to complete the construction phase.

Go Team!

Memorandum
From: Project Development Committee Chair
To: Executive Committee Department Representatives
Subject: Detail Designs Pending

There are a couple of issues surrounding the detail design documents. The first is that three departments have not yet provided even a rough draft. Of primary concern is the Solar System department. There are a few contingencies of other departments that require access to the Solar System detail design. Those who haven't turned in their documents yet are now two weeks behind schedule. Let's see if we can resolve this issue by the end of the week.

The second issue is directed at the Flora, Land Based Department. Essentially, the specifics for the plants described in your document would kill the zoologicals. Please review the flora/fauna interface document and submit an updated document by the end of next week.

Let's go, Team!

Memorandum
From: Project Development Committee Chair
To: Solar System Department
Subject: Rejection of Detail Design

I have reviewed your submitted detail design document and have not passed it to the customer for review. I'm afraid that it does not match the general design that was approved. While I do agree that a system of twelve planets, all in the same orbit at thirty-degree intervals, would be aesthetically pleasing, it isn't even close to the requirements provided by the customer.

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Your section is part of the project critical path. At this point the entire project is two months behind. I suggest some late nights are in order to get back on track.

Don't let the team down!

Memorandum
From: Project Development Committee Chair
To: Executive Committee Department Representatives
Subject: Change Request 001

The customer has submitted a change request to this committee. After additional review of the documents submitted by the Biological, Sentient Species Department, the customer has decided the sentient species should not be the blorcan. For some reason the blorcan is to be completely scrapped, and not even used as a animal species.

The customer sent sketches of what is desired. (See Attached.) The new species seems to be based on the simian series submitted by Biological, Mammals.

Unfortunately, the customer is not willing to give us any additional time to incorporate the changes. Given that we are three months behind schedule, I felt we had to give in as a show of good faith on our part. I figure the prototypes can be started now, and the creation facilities can be retooled so they will be ready as soon as we are ready.

Let's push forward. We can do it, Team!

Memorandum
From: Project Development Committee Chair
To: Executive Committee Department Representatives
Subject: Solar System Design Approval

Congratulations to the Solar System Department. Their fourth detail design was approved by the customer. The last minute addition of planetary moons didn't help them any, but they came through with an accepted plan.

However, all of the news isn't good. Because of the delays in approval, the materials that had been set aside for the project were used elsewhere: New materials have been ordered, but they will not arrive for another month. That will leave us only two months to complete the construction phase of the project.

Each department is being tasked to provide a production schedule using three shifts for a two-month period. Please include the expected output numbers as well. Since our original projection was well above the customer specifications I think I can sell the reduction.

Let's push forward, Team!

Memorandum
From: Project Development Committee Chair
To: Executive Committee Department Representatives
Subject: Customer Concerns

I thought it prudent to apprise each of you of a meeting I just had with the customer. I'll cut to the chase: the customer is not happy. There is a huge concern about our ability to deliver the project. I was quick to reassure the customer that we would indeed complete the project, and on time. I reviewed the work that has been done in prototypes and production line setup, and explained that most of the work outlined in the project plan was in getting those major tasks done. Yes, I know that is stretching it a bit, but I know you will not let me down.

I have promised the customer that once the foundation is in place, our production lines will begin to produce and populate the world. The customer was still a bit nervous, but after all the work that has already gone into this project,

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the customer decided to give us the remaining month we have on the schedule.

On a corollary note, the vendor has promised me that our materials will be here in the next two days.

Memorandum
From: Project Development Committee Chair
To: Executive Committee Department Representatives
Subject: Materials Here!

The solar system materials have finally arrived. We've only got seven days left of our construction phase, but I know each of you is committed to pulling out all of the stops.

I know everyone has been working hard to prepare for this moment. The customer has agreed to the reduced quantity, as long as we still meet the minimums specified in the original project requirements. After review of the project output of the production facilities, I think if we really push ourselves, we should be able to get everything done in six days. That will leave us the last day for observation, review, and some merciful rest.

It's balls-to-the-wall time, Team, let's go!

Memorandum
From: Project Development Committee Chair
To: Executive Committee Department Representatives
Subject: Project Postmortem

First of all, let me congratulate the entire team on a job well done! When it came down to it, everyone pushed the extra mile, and we were able to complete the construction in six days. The customer has reviewed the project, and said it was a good job. Everyone has been granted two weeks comp time off, effective tomorrow.

The final phase of the project was the review of the implementation. This memo is a summary of the findings, and it should be viewed as feedback on how to improve future implementations.

First of all, the giant reptile prototypes that were rejected by the customer were not properly disposed. Rather than following the proper disposal procedure, the prototypes were merely buried in the ground. Everything looks good on the surface, so let's just hope it doesn't cause trouble in the future.

Second, I know everyone was a bit bored and punchy during our delays, and we had some laughs at the cross-species prototypes some of the staff came up with, but they were never meant to be deployed. I refer specifically to the duck-billed platypus. Apparently someone didn't remove the profile from the production line, and now our little chuckle is part of the ecosystem. While potentially devastating, we are lucky that the customer finds it amusing too. Very close call there, Team.

Lastly, I'd like to know who put air-breathing animals in the oceans. They were not in any of the detail designs. I'll leave it to the department heads to find the responsible parties. I'm sure their reviews will also reflect their actions.

Great job, Team. See you in two weeks. ■

You never know what is enough unless you know what is more than enough.

— William Blake

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Some people classify sciences as "hard" or "soft." But you can't always keep them apart....

PLAYMATE

Charles L. Harness

It wasn't really much of a chess club. The YMCA gave us a room with tables on Friday nights. We brought our own boards and men. No clocks. It wasn't all that serious. A couple of chemists from the Lab, a pair of women school teachers, a chemical patent lawyer (me, Ben Miller) also from the Lab, several high school and college kids, a carpenter, and a shrink. Rarely more than a dozen players at any one time.

Our chessplaying shrink was Dr. Dennis Garrison. He consulted part-time for the Lab and I knew he took a special interest in my present partner, Allen Quaid, one of the young docs at the Lab.

On this particular night I had just finished a Ruy Lopez with Allen and we were still sitting there, holding a postmortem. Allen had been in a devastating auto accident a year ago. His wife Jasmin had been killed and he had emerged with rather curious cerebral damage. For example he could still beat me at chess, but he had a weird nervous problem. If he moved a piece with his right hand, half the time his left hand would retrieve it and make a different move. Dennis once explained it to me. "It's the 'alien hands syndrome,' caused by injury to the 'SMA'—a strip of cortex on top of the brain that controls movement. A surprising number of people have it. In the Lab, and concentrating, he's in fair control, but he still has mishaps. He'll eventually form new neural connections. Just a question of time."

Allen dealt with it at the club by playing with his hands folded in his lap and calling out his moves, like "Knight takes pawn," and so on.

The game we had just finished was deliberately modeled on one played a hundred years earlier. For this year was the centennial of the great tournament of 1914, when Czar Nicholas the Second had invited the greatest chessmasters of the world to St. Petersburg to battle it out for a small fortune in gold rubles. Lasker, the reigning champion, had been there, of course, along with Capablanca, the great Cuban contender, Marshall, the American wizard, Janowski for France, Blackburne, the English master, Tarrasch from Germany. Our little club had been reviewing the games. Some wonderful stuff there. We kept coming back to the famous Lasker-Capablanca game that had decided the winner of the tournament. Capa should have drawn, but he lost. This was the postmortem Allen and I were going over.

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I looked up. One of the lady schoolteachers was standing behind Allen. Dennis Garrison had somehow materialized at my right side. I said, "Allen, I think I've been bumped. Catch you later?"

I followed Dennis out into the lobby. I knew what he wanted. I knew because I myself had been thinking about it for the past several weeks. He wanted me to extract an invention from Allen Quaid and file it in the Patent Office pronto and save the neck of our dreamy misfit chemical genius.

The problem was this: the Lab had sort of a tradition, or maybe more like a rule, the chemists were there to produce innovative research, which is to say, to invent, to justify their existence by advances "beyond the ordinary skill of the art" (to use patentese). In academia the untenured professor had to publish or perish. In the Lab it was invent or leave. Filing at least one patent application every three years was accepted as meeting the requirement. There were occasional exceptions. For example, when the chemist was recognizably on the verge of something really significant and needed but a few more weeks for completion. But these instances were rare and necessitated Management Review, headed, of course, by Dr. Coudert. Dr. Barry Coudert, Laboratory Manager. Look him in the eye when you are talking to him, but be careful about your thoughts. He can tell when you are thinking "Barracuda."

Why should Dennis care? Good question. Theoretically Dennis was merely a part-time consultant. Management, ever suspicious and wary, let him use one of the storage rooms for his routine Friday afternoon visits. He was nevertheless theoretically on call twenty-four hours a day.

Why should *I* care? That was an even better question, and I didn't know the answer to that one either.

Two months after Allen Quaid returned from his accident Dr. Coudert (by phone) had requested New York Legal to look into the question of whether he could fire Allen because of the chemist's alien hands syndrome and certain other new mannerisms, such as carrying on conversations with his dead wife while writing reports or working at the bench. Now, Coudert was reluctantly reconciled to being unable legally to fire a man with Tourette's syndrome, a woman in a wheelchair, a gay person, a woman who claimed her ovaries had been removed by extraterrestrials, and a man who said sonorous grace at his table in the cafeteria. But he was grimly determined to fight any addition to the list. All this according to the legal grapevine.

New York Legal replied with a formal opinion, at ten thousand dollars, chargeable to Coudert's budget (which infuriated him) and pointed out that Coudert couldn't fire Quaid merely because he was peculiar. Indeed the only legal basis for terminating Dr. Quaid was professional incompetence; which is to say, if he stopped inventing. Ah! That cooled the fury considerably. Yes, that invoked the three-year rule. At least in Coudert's mind. We further learned that he had initialed the termination order a month ago and that the pink slip had been drawn up, duly dated as of Quaid's third anniversary two days ago, with severance pay waiting. The poop was, the exit interview was set for tomorrow and Coudert planned to handle it himself.

Twenty thousand years ago Barry Coudert would have been the tribal chief, leading the hunt of the mammoth and the auroch, and taking the juiciest cuts as his fair due. Admired, feared, respected. Such qualities had high survival value in the Neolithic world; but now, today, Lab Manager Coudert was only feared.

So Dennis Garrison and I were talking outside in the lobby. He said, "Allen is dead. He just doesn't know it."

"Sure looks that way."

"Unless he can invent something and

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file a patent in—" he looked at his watch "—four hours?"

I took a long deep breath and shook my head. "It isn't done that way." How could I get him to understand? "Dennis, listen to me. In our Lab a patent isn't just a single piece of paper—it's the tail end of a *trail* of papers. It starts with an Invention Disclosure. The chemist fills out a four-page blank. He describes his invention. He gives dates, when he first conceived it, when he reduced it to practice, where all this can be found in the Lab notebooks. Was it done under government contract? How about joint inventors? What is the closest prior art? How about related cases in the Lab?"

I studied his face. Sort of blank, waiting. His best noncommittal shrink face. Maybe he was getting this, maybe he wasn't. Sometimes Dennis didn't seem to live in my world. I went on. "I'm supposed to take everything in order, and there might be half-a-dozen older cases waiting attention ahead of the newcomer. Ordinarily I would make a prior art search. If the art is clear, I work up a preliminary draft. Everybody involved takes a crack at it. It grows. Examples are added, subtracted. The claims take shape. Finally, often months after submitting the Invention Disclosure, the patent application is signed and faxed to the Patent Office."

His shrug said, well, maybe a little problem or two, nothing we can't deal with.

My raised eyebrows said, no, Dennis. I took a deep breath. Then another. Dennis was familiar with all the big Lab projects, the people and the biochemistry involved, and the wonder drugs we so fondly hoped would come out of the work. "Look, Dennis, just by way of example, let's look at the *Beta* Project." I picked *Beta* because at present *Beta,* short for *Staphylococcus aureus betancourtensis,* was by far the worst of the drug-resistant killer bacteria and made a fine example for my point. "Allen has been forbidden to come near the work, but let's assume he tackles it anyhow. Tonight. Suppose he is successful—which he can't possibly be, but just suppose he does in fact successfully alter that critical little stretch of chromosomal DNA in the *E. coli* donor so that it will in fact express the correct polypeptide of the right size and shape and with a beautiful valine amino acid in exactly the right place." I paused, gave him a look that asked, Dennis, are you listening?

"I'm listening." he said.

"Okay, that's just for starters. His little string of DNA will have to be amplified, probably by polymerase chain reaction—PCR—to give enough to culture. Then stuck in the incubator at thirty-seven degrees at least overnight, then collected and the polypeptide extracted. He still has to test various strengths of polypeptide product on various concentrations of *Beta.* So far he's used eight or ten weeks, minimum, and he's cut a lot of corners. *Now,* maybe I can start the patent process.

"Yeah, the paper trail. I never said it was easy. Still—" Dennis was thoughtful. "Ben, I have a problem with doctor-patient confidentiality, but there's something you ought to know. Allen and I have already discussed this."

I didn't find that surprising. "You mean the three-year rule?"

"That, yeah, generally. But specifically, now that you bring it up, *Beta.* He thinks he knows how to make it work. And fast. He needs just a few hours."

I snorted. "With *E. coli?* Not likely. Still, if he's really got something, he should tell Coudert."

"He tried. That's when Coudert told him to stay the hell away from the project."

"So?"

Dennis studied me carefully. I suddenly realized he was about to ask me to do something very strange and very irrational. I debated whether I should break away, make a run for my car in the lot across the street.

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Too late. Our part-time shaman struck. "You and Allen and I are going back to the Lab. He's going to try to solve *Beta* tonight. I think he can do it. You can file the patent on your office computer tonight. Okay?"

There are some things so incredibly absurd, so magnificently insane, that only a total suspension of reality can deal properly with them. Like this one. My mouth began to open and close and open and close. When it stopped, I told him flatly, "You're crazy, Dennis. You know that."

"Fine," Dennis said. "I'll get Allen. We'll use my car."

At first, all three of us were silent as we drove over to the Lab. The silence grew increasingly uncomfortable. Finally Dennis said, rather tentatively, "That Ruy Lopez. Poor Capa. Lasker out psyched him."

I had to think for a moment. He was talking chess, just something to ease the silence. We were grateful for something to talk about. "Yeah," I said, "he screwed up in the mid-game." A brief silence. Sort of like a crotchety gasoline lawnmower. You yank the rope. A couple of put-puts. It's going. Or is it? No, it quits.

Okay. No choice. "*Beta,*" I said.

Big relief all around. Dennis and Allen were dying to talk about it, but we knew Coudert had ordered Allen to stay away from it, and everybody hesitated to start.

We all had something to say about *Beta—Staphylococcus aureus betancourtensis,* a microbe worse than HIV, worse than cholera, tuberculosis, leprosy, plague . . . fatalities were over 50 percent, and fast. You were walking around one day, dead the next.

Beta had been born in irony. In the closing years of the previous decade, the civilized world, while trying hard not to, had finally produced a microbe so resistant to antibiotics that no drug, singly or in combination, had any effect on it. It spread by casual contact—a kiss, a handshake, a cough, by breathing the air of home, school, or street. Hospitals were a major source. As the name suggests, *Beta* was a mutant of the old *S. aureus,* which in its day had been bad enough, but which had finally been conquered with synergistic combinations of vancomycin with other antibiotics, such as oxacillin. Whereupon, *S. aureus* had smiled and had mutated into *Beta. Beta* dealt promptly and thoroughly with all known antibiotics. As soon as the antibiotics entered a *Beta* cell, the cell's internal machinery flushed most of them out again through pumps in its cell wall. Simultaneously its ribosomes began synthesizing enzymes that ate any hapless remaining drug molecules.

Worldwide all the big drug companies (and, the little ones, too) had a zealous and jealous *Beta* project going. And worldwide it was pretty well assumed that the first to succeed was headed for Stockholm and the Nobel.

Dr. Coudert was among those who wanted to solve *Beta.* We had the impression he wasn't necessarily aiming to help the company, although of course that would be nice. *Beta* was *his,* his key to glory. And to this mysterious microscopic mistress he devoted an illogical fraction of the resources of the Lab. It was rumored he had even picked a name for his new drug, if and when he created it: Barricidin. Dennis Garrison, *sotto voce,* had once likened Coudert to the monomaniacal Captain Ahab and *Beta* to Moby Dick.

"I'll show you Jasmin's idea," Allen said. "It works with lasers. I'll have to work fast. Entry after hours may set off alarms. Coudert may come in."

As to Coudert, he was justifiably apprehensive. But—*Jasmin's* idea? A slip of the tongue?

And so in to the entrance gate, signing in with the guard, and ten minutes later we were at the locked doors of the Bio Bay.

"I have an entry card," I said. I knew all the codes. I had helped install them.

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And a dozen security cameras.

We entered, Allen turned on the lights and we looked around.

"Where are these famous lasers?" Dennis asked.

Allen pointed.

"Looks like my washing machine with an outsize TV," Dennis said dubiously. "You sure you can make it work?"

Allen said, "Actually, it's pretty simple. I sit at the console, I watch the monitor and Jasmin tells me how to use the joysticks to control the laser tweezer beams and scissors beams."

Jasmin? I tried to catch Dennis's eye but he was wearing his blank maybe-later look and was no help.

Allen continued. "The infrared lasers focus at 499 nanometers—about 500 times the diameter of a strand of DNA, and the beams shine into a confocal fluorescence microscope, which in turn feeds the image to the monitor. Everything is automatically recorded on tape." His voice tightened a little. "We'll have to do this quickly. Jasmin and I are not supposed to be here, you know."

There was no good answer. "So I guess you'd better get right to it," Garrison said. "Give Ben a running commentary as you go along, so he can write up the patent."

I got my dictapad out. "Right. The patent must start with an abstract, just a short paragraph. Can you give me a summary of what you are about to do?"

"Sure. It's several steps, all very simple. Basically, she will alter the DNA in a plasmid in a cell of *Escherichia coli.* She'll change a terminator triad from adenine-cytosine-thymine to cytosine-adenine-thymine, which translates to guanine-uracil-adenine in messenger RNA, and which will then code for the crucial amino acid valine. The resulting strand of RNA will then express a polypeptide that will fold into a shape such that it will paralyze the ribosomes and plug the pumps in the *Beta* cell. The antigen dies. *E. coli* replication preserves the alteration."

I got all that. But—"*She?* Do you have a joint inventor?"

"Well, not exactly. It's all Jasmin's idea. She's the *sole* inventor. I'm just a pair of hands."

"Oh." Allen had probably discussed *Beta* with her. Dennis Garrison totally refused to meet my eye. I said, "All right, you can sign for her, as administrator of her estate."

Allen walked over to the incubator. "This'll take just a minute. I have to isolate a single *E. coli,* suspended in isotonic plasma on a special mount for laser access."

While he was gone I whispered to Dennis, "He really thinks she's involved? What's going on? *Give.*"

"Okay." The psychiatrist looked over toward Allen as he talked. "He credits her for figuring out the right shape for the polypeptide and how to get it. It's one of those gender-difference things. Women have better access to their right cranial hemisphere than men. They can match things better. Round plug to round hole, that sort of thing. Actually quite a feat for male *or* female to predict how a stretch of polypeptide will contort and curl and fold. Like wadding up several yards of microscopic Scotch tape. Allen insists it's all her idea. He'll probably claim he's following her directions when he starts the experiment. Think you can handle that?"

I grimaced. "Doesn't he know she's dead, just a neural imprint in his cerebral cortex? Is this good for him?"

"Yeah, a problem, all right. That imprint is why he skips therapy sessions and refuses to take his medication. He's afraid I'll take her away. I don't like it, Ben. But I like the alternative worse."

I sighed. I knew what he meant. Allen believed Jasmin was going to tell him how to run the experiment. No Jasmin, no experiment, no patent, no life. Okay, for now, let it go. For now she's the rock he stands on, his crutches, his training wheels, his instruction manual. "Alien hands?" I muttered.

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"No problem. *She* will help him concentrate."

You too? I thought.

Allen returned to the console. I said, "Coudert tried very similar genetic engineering. His didn't work. What went wrong?"

"Yeah, I heard about it. Big disappointment." The young biologist shrugged. "According to his computer program his *E. coli* polypeptide should have worked, but it didn't. Oh, it penetrated the *Beta* cell membrane in fine style—but was immediately pumped out again. It was the wrong shape to plug the pumps."

"So it couldn't stay inside the cell long enough to disrupt the cell machinery in *Beta?*"

"Right. After all that work, his polypeptide folded into the wrong shape, and the *Beta* ribosomes continued to churn out toxins—bad stuff that destroyed white blood cells and degraded tissues and provoked pneumonia."

"But your alteration will give the right shape?"

"Theoretically. But of course we have to make it first and test it." He was cool, confident, almost nonchalant.

Suppose his crazy idea actually worked? But it couldn't work. Barry Coudert, with all the facilities of the Lab at his beck and call had already tried, and had failed, and was still trying. If anybody succeeded here, it would be our unloved Lab Manager.

Oh well, it was still kind of fun. As Micawber said, maybe something would turn up. I was ready to file a patent on anything halfway novel. A new kind of microscope mount . . . a new and useless stretch of DNA . . . a new laser mechanism . . . anything to beat the infamous three-year rule. Make me an invention, Dr. Quaid.

I said, "How did you decide what polypeptide shape was proper?"

"Jasmin told me. She's very good with shapes, how the pump orifice is configured, how the polypeptide must fold in order to match, and so on."

"Why, that's fine, Allen. She wrote it down somewhere? Before . . ."

"No, she told me just a couple of weeks ago. I told Dr. Coudert what she said, but he wouldn't listen. He was . . . unpleasant."

"Oh."

There was an uncomfortable moment. Allen said, "Look, we achieve good magnification on the meter-square monitor. Even so, laser surgery at the nucleotide level can involve a certain amount of guesswork. DNA is just one nanometer in cross-section. The molecules of its nucleotides are even smaller. Hydrogen is one-tenth of a nanometer. We'll be looking for a specific A-C-T triad—that's adenine-cytosine-thymin. It's so small we'd probably miss it if we didn't know exactly where to look."

"Why A-C-T?" asked Dennis.

"Two reasons," Allen said. "Like I said, it signals 'stop' on the DNA. As it stands, no polypeptide is made beyond that. She changes it just a little. She reverses the adenine and the cytosine. That way it reads for valine, not 'stop.' So the resulting polypeptide is bigger, and with valine in the right place it folds into a shape that plugs the pump vents in *Beta* and also wrecks its ribosomes. The antigen dies."

All I could think was, this is insane. It can't work. And *she . . . she . . . she. . . ?*

Allen took his seat at the console. He said softly, "Ready, sweetheart."

I shot Garrison a quick look.

The shaman drew nearer and whispered almost inaudibly from the corner of his mouth. "She'll give him step-by-step instructions. Take it all down."

"But—!"

"Shut up and listen. You'll have to get all this on the record."

I was outnumbered. For the moment all I could do was make sure my little recorder was on and try to follow Allen's deft and subtle handling of the joysticks, where one inch equaled a laser beam movement of one nanometer. Not the

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slightest wobble or retrace. Jasmin? Whatever . . . his skill was a delight to watch.

The experimenter said, "We're now through the double phospholid outer membrane of the *E. coli* cell. Rather squishy. Then on through the watery cytoplasm and right to the plasmid. Now we wait a second while Jasmin calls up a map of marker genes. This is a new strain, fresh from American Type Culture Collection—ATCC, and the genome differs slightly from the standard *E. coli.* Okay, she has it. We follow the map, along hundreds, thousands of nucleotides, searching, for the STOP. *There!* It's our tell-tale nucleotide triplet: adenine-cytosine-thymine. Genes beyond that barricade lie inert, sleeping. She's going to wake them up. For our next step, in order to better see the nucleotide molecules she'll pause for a moment on the sensing strand while I step up the monitor magnification."

As we watched the screen, the fist-sized cyclics of the nucleotides began to grow. Soon the purine and pyrimidine rings nearly filled the screen.

"The atomic nuclei are still too small to see clearly," said the biologist, "but it won't matter. She will work with the outer electron shells."

Of course, I thought.

Allen looked up at us. "Jasmin says the cell is full of nutrients. It's in the S phase and will soon start doubling. She has to hurry."

So she was right there with him. Which is to say, he was generating his dead wife in one part of his brain and switching the image to another part as genuine sensory input. "Please keep up the commentary," I said.

"Okay. We tweezer in to the sensing strand of the helix, and now I turn it over to Jasmin."

That didn't sound quite right. I looked over at Dennis, but he just shook his head.

The thing that happened next clarified everything and raised the hair on the nape of my neck. Allen was speaking softly, but it was the voice of a woman: "First I break the weak hydrogen bonds, then the stronger covalent bonds. I wrench adenine and cytosine from their deoxyribose bases, quickly transpose them. Then I reach over to the anti-sense strand and make the same switch. Finally and very quickly I tweezer the inner bases of the four nucleotides together, matching up the hydrogen bonds once more."

Dennis was staring at Allen, then back to me. His jaw was hanging slack. You too, I thought.

Allen cried out in his own voice, "And just in time! Wow! It's replicating! Jas, look at that!" He pointed.

Dennis and I watched the monitor in wide-eyed paralysis as a big blob of something swept across the screen. Figure *that* out later.

Just now I had only one question. Had we really heard Jasmin Quaid? I wanted to know. A woman's voice was permanently written in both the printed and the TV records. I wanted to ask Allen, Dennis . . . But I didn't, and Dennis seemed relieved. It was just as well. I had achieved my very modest reputation for wisdom by keeping my mouth shut at critical times, which would now include this one.

"That was polymerase," Allen explained happily. "It grabs up molecules of nucleotides, sugars, phosphates—right and left, and throws them into their proper niches in the growing DNA double helix. Including," he added (rather smugly, I thought) "her newly created valine codon—which is now hereditary. And as we watch, we can see the altered DNA turn out RNA to make her new designer polypeptide, the one that's going to kill *Beta.*"

We watched a string of nuclear bases float across the screen.

"Her finished polypeptide is about 100 nanometers long," Allen said. "Now it'll begin to fold. Hydrogen bonds will form between amides and carbonyls, at

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about every fourth amino acid residue. That causes it to curl up into a little sphere, about five nanometers in diameter. We let the culture run for a few more minutes, until we get a sufficient number of spheres."

We waited. Would we hear her again?

Allen was cool, but I was breathing hard and sweating profusely. So was Dennis, I was happy to note. I tried to think of other things. Tweezer, as a verb. Remember that. You have to use art idiom in the patent application.

Allen stood up and stretched.

"Now what?" I said.

"We have to test it. Will it plug the pumps in *Beta*'s membranes? Will it wreck *Beta*'s ribosomes? Ordinarily we'd culture overnight, extract the antibiotic with butanol, vacuum strip, resuspend in plasma. Do all that later, maybe. Just now, though, we'll save some time." He walked over to the incubator and was back in a moment with a covered petri and a wire loop. "*Beta.* We isolate one cell and add it to the plasma. Like so. The laser tweezers it. Next we micropipette a few dozen molecules of Jasmin's new polypeptide into the *Beta.* Like so. And now we watch."

He didn't need to say it. The three of us were glued to the monitor.

He said, "*Beta*'s killer cytoplasm loses no time. There—it's already pushing one of Jasmin's polypeptides toward a pump orifice."

We waited in silence. I wasn't surprised, and I guess neither was Dennis, when Allen's eyes seemed to close and he spoke in a whispery feminine monotone. "Gentlemen, as you can see, my polypeptide completely plugs the hole."

And here Allen took over and continued in a professorial monotone, "Meanwhile, we see another polypeptide molecule has just disabled a *Beta* ribosome and is going after another. In fact our boys are all headed for more pumps, more ribosomes. It's a slaughter. We win. *Beta* has disintegrated." He looked at us and grinned. "Ben, you got enough for the patent?"

I guess that meant she had gone. "I think so, but I think we'd all better go around to my office to draft the case and fax it in to the Patent Office. Bring the tape. Dennis, if you can come too? We may need you to fill in some blanks and witness some records." I looked at my watch. "Not bad. Two A.M. and still no Barry Coudert." I thought of the Lab Manager and the tape. He'd eventually have to see—and hear—it. I paused for a brief smile. Jasmin's voice was going to freak him out.

The rules for drafting a patent application are at least as strict as the rules for composing an Elizabethan sonnet or the Mozartian mandate for the minuet. Deviation may occasionally be forgiven, but is nevertheless considered bad form and a lack of breeding. So I dictated into the transcriber with due care and protocol. I knew this was going to be a historic document, like Whitney's cotton gin patent, or Carothers's patent on nylon.

Allen leaned over one shoulder, Dennis over the other.

First the Abstract—almost exactly as Allen had provided. Then, Background of the Invention. No problem there. I described efforts—futile until now—to find an antibiotic effective for *Beta.* Next, the Summary of the Invention. Easily stated. Followed by Detailed Description of the Invention. This was the place for the step-by-step recital of how to change A-C-T to C-A-T, then allow the modified plasmid to replicate and make lots of polypeptide. Follow with Example I—making the polypeptide, with times, quantities, laser beam wave lengths. Tweezing. Example II—Impact of the Polypeptide on *Beta.* To make sure I didn't leave out anything, I included Exhibit A—a full copy of Allen's tape of the run.

Dennis said, "How about something on administration and dosages?"

"Guesswork," Allen said dubiously.

I said, "The Office will accept it, so

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long as we say it's our best guess. Actually, there's a standard paragraph for this. We've used it before, for solid, liquid, oral, injectable doses." I called it up from data storage. "Now for the claims." I resumed dictation, "I claim—meaning you, Allen—"

"Whoa! *She's* the inventor!"

Jasmin again. I fought an urge to turn around and look for her. "Allen, we appreciate your modesty, but think about this carefully. Are you *sure* it's all her conception? That you merely followed her instructions?"

"You saw it all. I was just a pair of hands."

I gave him a doubtful shrug. "Well, okay. It's still 'I claim,' but meaning Jasmin Quaid. You can sign now as her personal representative and file your certificate of administration later."

So I proceeded with Claim 1, directed to a novel altered *E. coli* plasmid, "the alteration consisting of . . ." And so on. I really went to town. Several more product claims to cover the resultant RNA, the lovely new polypeptide, and of course claims to methods of making and administering the new products. And then the cascade claims . . . "The method according to Claim X wherein the concentration is . . ."

It's the claims that describe and define a patent monopoly. When you go to court to enforce the patent, it's the claims you sue on. I was determined to claim Jasmin Quaid's invention fifty different ways, up, down, sideways.

When I finished, she had fifty claims, and they would probably take up two full pages of the patent—if and when it issued.

"We're done." I typed in an instruction on the keyboard. "We're going for a world patent under the International Treaty." I handed Allen the transmission plate and the stylus. "The rules require a biblio of the closest prior art you know about, but that can come later. Sign here, 'Jasmin Quaid, deceased, by Allen Quaid, administrator of her estate."' He did this in silence.

I said, "Allen, before I forget it, sometime tomorrow you'd better get some bio deposits over to ATCC in Rockville."

He laughed. "On the way. And it's been tomorrow for several hours."

I looked at the wall clock. Nearly four. Hmm. The time really passes when you're having fun. I turned back to the computer and inserted the signature sheet into the transmitter as the last page of the document. The patent application was now ready to send forth on its several world-girdling electronic journeys. All I had to do now was say one word to the computer: "Send." "Any last thoughts, anybody?"

No last thoughts.

The door burst open behind us. We whirled around in varying reactions of surprise and alarm.

"Stop—right—there!" cried Dr. Barry Coudert. "What in the name of heaven do you people think you're doing! You're all fired!" A tall grim-looking security guard stood behind him. I noted that Coudert's pajamas peeped out from his pants cuffs. He must have dressed in a big hurry. How had he known? Closed TV in the Bio Bay? Figure it out later.

I hate confrontations, especially the sudden unexpected ones. I may have looked calm. But I knew my heart was racing. I cleared my throat. "Excuse me." I turned back to my microphone. "Send," I said. Pretty squeaky voice. Did Madame Computer recognize me? Yep. A laconic acknowledgement. "Message sent." I held up a finger. "Ten seconds." A little bell sounded somewhere. I smiled. "Ah, the Hague acknowledges. Now, Barry, you were saying—? Oh yes, about firing everybody. We need to talk about that. You can't fire me, Barry. I report to General Counsel, in New York. And you can't fire Dr. Garrison, either. He's not a company employee. Now, about Allen Quaid? You've already fired him, Barry. Actually, as of yesterday, according to records in Personnel. Firing him again would look rather stupid,

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wouldn't it?" I smiled at Dr. Coudert.

He growled and clenched his fists. He did not smile back. "All right, so now he's an outsider. All the better! I'm having him arrested for trespassing." He glared at the ex-employee. "I know what you've been up to, Quaid. You had strict orders to stay away from *Beta.*" He turned back to the guard. "Arrest that man!"

Dennis Garrison stepped between them. "The media will have a feeding frenzy with this, Barry. Think of the headlines: LAB JAILS CHEMIST WHO SOLVED BETA. You'll be famous."

Coudert looked at us in astonishment homogenized with anger and fear. "No! He didn't! He couldn't have! You are all crazy! *I* am going to solve *Beta.* Nobody else! Just me!"

I shook my head. "Too late, Barry. It's true. It's all on tape."

"No! It can't be! Give me the tape!" He motioned to the guard.

I laughed, pulled it from the slot in the computer and handed it over to the increasingly bemused security officer. "Help yourself. By now there are duplicates in the Patent Office in Washington and in the seventeen patent treaty countries." I picked up the phone.

"What are you doing?"

"I'm going to call the local media, the *New York Times, Wall Street Journal.* They'll want to interview Allen down at police headquarters when he makes bail."

"Wait . . . Ben. Maybe. . . . Please?"

The Lab dynamics had suddenly shifted. It was as though the building had moved on its foundations.

I put the phone down.

Coudert's voice was barely audible. "You mean . . . it's *true?* "

"Yeah, it's true."

"I see. Well, not that I necessarily believe you, but whatever it is, at least the company owns it."

"Why do you say that, Barry?"

He stared at me. "How can you ask? It's in his employment contract."

"He wasn't an employee when he and his wife made the invention. Neither one, as a matter of fact."

"His *wife*. . . ?"

"Actually, she's on the patent as the sole inventor."

The security guard handed the tape to Coudert. "I think this is out of my department. Dr. Coudert, I'll be at the gate house if you need me." He vanished.

The Lab director tucked the tails of his pajama top into his britches. "Ben, I don't understand you. Whose side are you on? The company must have *some* rights!"

"Oh, indeed we do. However, under the rather unusual circumstances we have here, I don't believe we own either the invention or the patent. They belong to the Quaids." I shifted into my authoritative opining voice, reserved for anxious clients. "But we're certainly not out in the cold, either. Allen used company facilities to reduce his invention to practice, so under the common law we have a shopright, which is to say, a non-exclusive license to make, use, and sell the invention. Not a monopoly, but we can still make a lot of money, especially if we can persuade Dr. Quaid to stay on as a consultant."

"And Jasmin," said Allen.

"Jasmin." Dr. Coudert closed his eyes, moaned softly, and collapsed into an empty chair. "How much with Mrs. Quaid?"

Allen named a figure. It was more than the published annual salary of the company president. Coudert moaned again.

Allen added, "Jasmin says we should name the new drug 'Barricidin.'"

Coudert thought about that. "Barricidin. Well . . . Hmm. Barricidin . . ." He looked up at Allen. If the Lab manager had known how to smile, I think he would have. "The board meets Tuesday. I'll recommend . . . everything."

Two years later Allen stopped by the Y briefly on his way to the airport and

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Stockholm. He shook hands with old friends, including Dennis Garrison and me. He said, "All Capa needed to win the Petersburg tournament was a draw. It's all psychology—he let Lasker outpsych him. Jasmin is gone now, but before she left she explained what Capa should have done. Here, let me show you." We watched him move pieces on the nearest board. I was thinking, something odd here. We waited. He didn't take the moves back. No more "alien hands?"

Dennis rubbed his chin thoughtfully. "Good move. Yes, that might well have done it."

A moment later Allen was gone. I waited, then invited our reluctant shrink over to a corner away from the others. He must have seen what was coming. He refused to meet my eyes. I took his lapels in my hands and I held him against the wall. "Dennis, I have done some checking. She was never in this club. She never came here." I was gathering strength and hissing at him like a broken steam pipe. "There was no Jasmin Quaid in the accident report. Nothing in the papers about a funeral. And back there in the lab . . . her voice . . . *he* was doing that, wasn't he?" I snarled at him. "In fact there was no Jasmin at all, never, ever, except in *his* head, and *yours!*"

He eased my hands from his jacket. He looked me straight in the eye, genuinely puzzled. "So what? She saved his sanity, perhaps even his life, at a crucial time. Think, Ben. For him she was not just a collection of neural circuits. She was *real.*"

I groaned. "But she's on the patent. It's prima facie invalid." Sooner or later, I thought, some stupid thing would happen to me that would get me disbarred. Maybe this was it.

Dennis shrugged, rather casually I thought. "So maybe there's a little problem. But it was all done in good faith. You're a lawyer. You can fix it."

I shook my head. "As a minimum that would require a sworn statement from Allen that she didn't exist. He'd never sign. From his viewpoint that would be perjury."

He considered me with sardonic amusement. "So what are you going to do? Report it to the *New York Times?* The Bureau of Vital Statistics? The local sheriff?"

"Don't be ridiculous."

He sighed. "If it's any comfort, the Nobel Commission had some problems with Jasmin, too. I was on the phone most of yesterday with them, explaining things. They'll compromise—Jasmin and Allen will share the award, and he can represent her at the ceremony. He'll come out okay."

I considered that. What was going to happen when the reporters tried to find Jasmin? I didn't say anything.

He continued. "It's simple. Look, Jasmin goes way back. As a child Allen had no playmates. He was very lonely, so he created her. To him she was real, *really* real. He could see her, talk to her, play with her. The phenomenon is actually fairly common. What child was she? Nobody, everybody. A protean composite. As he grew older she faded away. She returned after the accident."

"But he says she died in the accident."

"Quite so. After that he talked to her ghost."

I thought I had handled the initial step into surreality fairly well. But this was way beyond that. I had an empty sinking feeling. "The *ghost* of a phantom playmate."

"You got it."

I took a long deep breath. "And you knew all along. Why didn't you tell me?"

"Think about it, Ben. You would have refused to put her on the patent, he would have insisted, there would have been a bad scene, he would have regressed six months, a year, maybe forever. This way he's cured, on his way to his Nobel, I'm happy, you're happy, Coudert is. . . well, maybe just a little unhappy. You could hardly ask for more."

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"*I* am *not* happy."

He smiled. "Ben, what you need is a good game, take your mind off your troubles. Did you know the young Russian student Alekhine actually tried to pull a king's gambit on the great Tarrasch?"

"Surely not at St. Petersburg?"

He took me by the sleeve and led me back to our table. "Yes indeed. Tarrasch was insulted, of course. He countered with a Falkbeer. He was so mad he lost. It was all psychology. Here, let me show you." ■

JOSEPH H. DELANEY, 1932-2000

Joseph H. Delaney, for many years one of *Analog's* most popular and prolific authors, died at his keyboard sometime in mid-December, 1999. He was found by neighbors on December 21 in his home in Alpine, Texas; an autopsy indicated the cause of death was heart attack.

Joe Delaney was born in Alton, Illinois, and educated at Eastern University in Baltimore, Maryland. He served in the United States Army and was a practicing lawyer for 25 years.

His professional relationship with Analog began almost unintentionally with a letter to the editor. Like many long-time readers, he felt an almost proprietary interest in the magazine, and wrote a long letter wishing that the law could be as accurately treated as the science in our stories. Challenged to try his own stories that did just that, he responded with "Brainchild" (June 1982), one of the most impressive debuts on record: his first story, it earned a Hugo nomination for itself and a John W. Campbell Award nomination (as Best New Writer) for Delaney, with nothing else yet in print. He became a full-time writer in 1983, and a veritable torrent of other stories followed over the next several years, covering a wide range of subject matter and tone but often including some of the best examinations in science fiction of how technology and the law might interact in our future. One particularly noteworthy series of novelettes, written in collaboration with Marc Stiegler, eventually coalesced into the novel Valentina, widely considered one of the outstanding stories of a sentient artificial intelligence.

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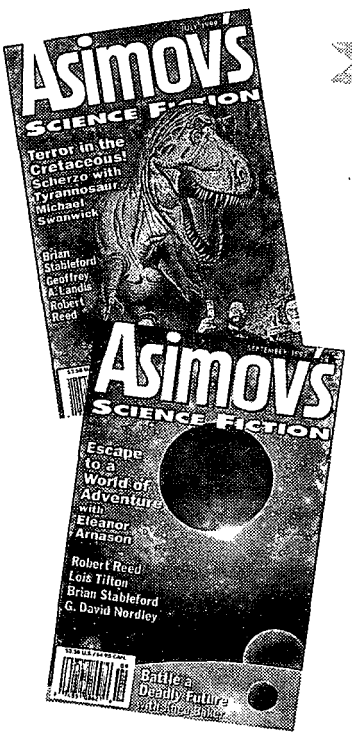

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Robert Burns was onto something, but a mirror can be a trap—which is not necessarily a bad thing...

REFLECTIONS

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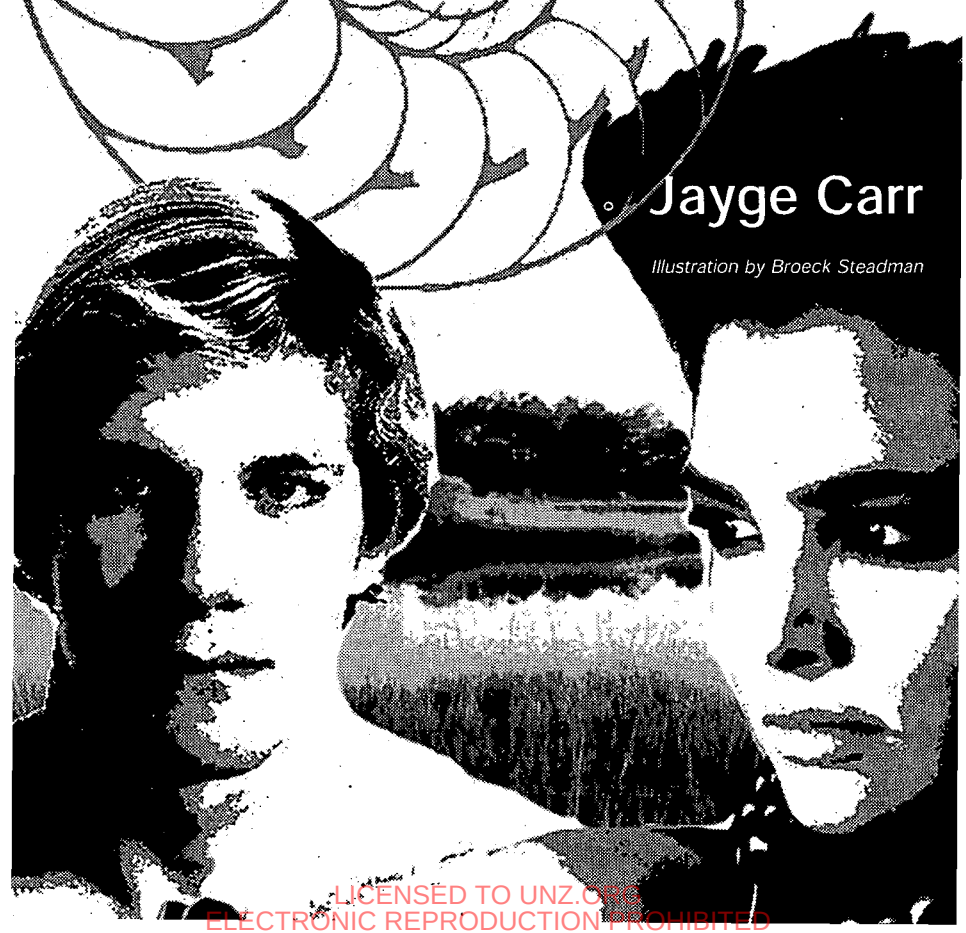

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Amber Matanzima had never backed down from a challenge in her entire life, and she didn't intend starting a precedent at age twenty-four. She knew the Rules, and the Penalties, too well.

She watched, cool face camouflaging the layered guile within, while the captain nervously eyed her tapping foot, each toe with its surgery-added length and prehensile extra joint tipped with a different animate, all crooning in harmony at the rhythm of her movements.

She read him as if his face were a screen, he might as well have said it aloud. *The captain is lord of all he surveys!*

Except, Amber knew, *for what is surveying* him.

"Well?" Amber inquired sweetly. Surgery plus training had given her a melodious contralto voice, with (when she wished) an undertone of command in it as hard and cutting as a flake of flint.

The captain rolled his eyes ceilingward and prayed for guidance. Amber made an inward check mark on her personal score pad, having found her Hold on him. If he didn't do what she wanted, she, the Matanzima Heiress, would have his family jewels for a necklace. But if he did do what she wanted—

She knew what was twisting in his guts, Amber's Original, Old Lady Matanzima, the starfires around her neck and in her hair less cruelly lovely than the glint in the silver-gray eyes, a hundred and fifty years of sheer power on the hoof.

Amber knew much better than he did what the Old Lady was capable of. But the captain knew . . . enough.

Yet Amber was here and the Old Lady on her L5, a good many lights away. A long enough spoon to sup with the devil?

"It's not a rated world," he tried one more time.

"I haven't seen it." She had said that before. More than once. Impatience gave her voice an extra sweet note.

He shivered. "It's not safe."

"Then your crew shouldn't go down."

"Just long enough to load the ore and bring it back up." Desperately: "Lady, it's a dull world. Nothing that can't be seen on a dozen others. Once we finish here, we'll be heading for Sybarite. Sybarite," he repeated the famous slogan enticingly, "where all your dreams are made flesh, and—"

"I've been there," she interrupted the Sybarite motto, the mood-symbiote implants under the skin around her eyes a hard green, making her look like an angry, technicolor raccoon. "Often."

He groaned. Most people would sell their soul (or right arm) for even the shortest tour of Sybarite. But most people weren't Heiress to the owner of one of the biggest space companies, plus better than half of a solar system. A *rich* system.

"I don't dare delay," he warned. "Down, look around while my crew loads, and back up."

Amber smiled.

The captain groaned again.

Amber's smile broadened. He only thought he knew what disaster was.

"You want to *what?*" The captain's voice broke like an adolescent boy's.

"Stay." Amber smiled at his aghast face on the shuttle screen, her favorite feral smile, which one of her tutors had said reminded him of a piranha's open-mouthed hunger. "Here."

The captain looked as if he wanted to cut his throat, but she knew, as he had to consider, that he had a family. If he lived and took the brunt of the Old Lady's wrath, she *might* spare his family. The worst of it.

Power. Balance. She had learned to control all those around her in childhood. She had *survived* by controlling and winning every time. Now she often didn't even have to think about it.

The captain's hands twisted, as though he were strangling a slim and

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graceful neck.

Amber noted the hands, nodded to herself. She had the man well and truly impaled on the horns of the dilemma she had devised for him.

The Old Lady . . . the Heiress . . .

Well and truly broken to harness, Amber decided. She took him out of his misery. A little. "You can come back for me. After Sybarite."

"Come back?" A reprieve. In a sense. Flaying alive wasn't so bad after all.

A merry tinkle of laughter. "Here. After Sybarite. To pick me up again." A frown, another twist of the controlling reins. "You seem slow, Captain. When was your last rating?"

Slow, but: "Lady," he said hoarsely, a beaten man, "if I turn back for you after Sybarite, my schedule will be irretrievably behind."

She smiled slowly, knowing that a piranha, seeing that smile, would have fled instantly, all its primitive instincts alerted.

The captain had no such choice.

Amber's mood implants darkened to imperious purple, as the toothy smile broadened.

Amber flicked off the screen smugly, the feral smile fading to a thoughtful, pleased one.

Another tool broken to her usage. And all it was going to cost was a few weeks of her time on a new world. Probably pointless, but it was a world she hadn't inspected, and who knew, she might find a new product, a new service, a new—New here. Her Original would appreciate that, not because it would bring them both more creds, but to prove once again that she was an accurate replicant. The *best* accurate replicant.

She hadn't struggled and clawed and schemed her way to the top by ignoring any possibility.

Pleased at how quickly she had polished off her latest, Amber turned to face the bosun commanding the shuttle.

"My baggage unloaded," she said, statement not question. It had better be.

The bosun was a hard-faced older woman, no mods, her age showing. There was an unbroken glint of satisfaction hiding somehow behind her bland acquiescence, her servile tone. "Yes, it is, madam."

Amber flicked a glance at the name tag on her breast. Mendanio Dascalescu. She'd have to pay her a bit of attention when she got back. She was the Heiress; when she said frog, her subordinates didn't ask how high, they cracked their heads on the ceiling. It was practically Rule One on the Original's list.

This Dascalescu would have her turn.

The bosun turned to lead the way out of the shuttle. (Though Amber knew it better than she did. The Old Lady had had her totally educated, she could have flown the shuttle, or the ship, repaired it, even made design changes. Knowledge is power.) On the metal wall, the older woman's face reflected for a second.

Smiling.

Amber put a check beside her mental note to make sure this one couldn't sabotage her in secret.

The captain might be useful for that.

All the way across the field, Amber could feel the glare of the bosun on her back. So she strolled even slower, knowing the woman wouldn't dare take off until her passenger (and attendants) were well out of the blast area.

But where to go?

Her two best bodyguards, both sublimely attractive, excellent studs, marched behind her stolidly.

Behind them, her third favorite maid minced along, her sullen anger as tangible as if she sniffed every step instead of plodding along in silent resentment.

Like the men, like all Amber's servants, the maid was a gorgeous physical specimen. Status symbols.

And beautiful servants could be used in so many ways. . . .

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Keep them off balance. Always.

Amber slowed down even more, looked around.

The "field" was a flat piece of pressed earth, no fence and one (Count it, one!) small building plunked on the perimeter. Beyond that was a scatter of irregular lumps that could have been native plants, piles of supplies, almost anything.

It should have looked drab, except for the colors. The ground glittered silvery blue, and the lumps were brightly colored, turquoise and frosted rose, carmine and teal, peacock green and—

The scents, too, varied enticingly. She amused herself trying to identify them. Cinnamon and gardenia, cut with a sea-salt tang, and a hint of fresh manure sweetness—

It was a long walk across the dusty field. Where were the mobiles?

Somebody was going to pay for this!

The building looked like a child's drawing of a house. As though someone had picked up a palette of colors and used them to paint a wall in vertical stripes.

They weren't striped. They were individual round columns, each a different color.

The door was some sort of hide, which the foremost of the guards pushed easily out of the way.

One guard led her inside, the other stayed out, alert and ready. The maid simply slithered in, available but unobtrusive. All three knew better than to speak without specific orders.

"I want transport to your town." Though she hadn't raised her voice, every one of the natives (colonists; they were obviously Earth stock) inside the single crude room looked up.

Except the male crooning over a large piece of half-unpacked equipment.

"I said—"

The roar of the take off drowned her words.

She waited impatiently for it to die away enough for them to hear her.

"I want transport to your town."

"The ship's taken off." One of them, an older male, stated the obvious.

"They left someone."

"How could they?"

"Oh, *mother!*"

Amber smiled. "I'm Amber Matanzima," she informed. Odd. There was no reaction to her identity, just the gaping amazement at the presence of *any* offworlder. "Amber *Matanzima.*" Still no reaction. She hid her own. "They'll be coming back for me in about three standard weeks. Until then—"

"Three weeks?" said the older man, one of those who had spoken previously. He was chewing nervously on a bushy auburn beard. "It might—"

"Yes," she drawled, "I realize you may have difficulty keeping me amused for three whole weeks, but I'm sure you will do your pitiful utmost." Behind her smile was growing puzzlement. This blank reaction to her name was unheard of.

"Why is your captain doing this to you?" asked a woman with chestnut braids entwined with blue ribbons swinging down past her hips.

"I ordered him. He's my captain, he works for me. I'm Amber Matanzima," she said for the third time.

"You ordered?" said a thin, older male with an incongrous Santa Claus paunch.

"You ordered *your* captain," the beard-chewer said with a frown. Then the spark caught the tinder. "Matanzima. As in Matanzima *Company?*"

Amber nodded, regally.

"You're part of—"

"Heiress."

Something passed among the people in the long room.

Amber hid a small frown behind her third-best (good enough for *them*) intimidating smile. They knew something she didn't. Something important. She wanted, had to know what. Knowledge is power, her Original had said over and over. It was truth.

But she'd find out soon.

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Or else.

"If I need acclimatization medication, I would assume I should have been given it," she said very softly. (Hearing that tone, her personal servants knew to run if they could, try desperately not to attract her attention if they couldn't. The inside guard stiffened and came to full alert. The maid cowered, camouflaged herself as best she could in the shadow of the guard's bulk.)

"There is no acclimatization," one of them started.

"For three weeks, it isn't necessary," said another, and stopped.

The natives looked at each other.

"*Do* I need acclimatization?" she asked even more softly. (The guard instinctively made a move for the door, before remembering what would happen to him if anything happened to *her* while under his protection, and freezing where he stood. The maid slipped completely behind the guard, liquid-violet eyes wide.)

"Yes."

"No."

"Not for three weeks."

"Good." She decided to accept that she didn't need acclimatization. "Where is my transport?"

"We don't have mechanical transport," beard-chewer informed, "but we do have a hox-drawn wagon coming to take these." He gestured. "Once they've been unloaded, it can return for you."

Her foot began to tap.

Beard-chewer wasn't stupid, just totally unaccustomed to catering to the whims of the brutally rich. "Is there something else I can do?" he mumbled.

She smiled . . . sweetly. "I go first," she informed. "With my baggage." The crimson cases were easy to spot, she waved a languid hand. "I shall require a full suite in your best hotel." She paused. Six faces were staring blankly at her.

"What's a suite?" asked Braids.

"What's a hotel?" added Beard.

Amber was stymied, for a second anyway. "What do you call where people stay when they're only visiting, not living with you?"

Again the wordless message got passed around.

"If someone from another village comes here for any reason," Beard said slowly, "they stay with whoever invited them, or who has the most room to spare."

"There's little room to spare," Braids added.

"Whose home is the biggest?" Amber asked, too sweetly.

"We're simple folk," Braids informed, ribbons twinkling as she nodded, as though confirming her own statement.

"Gingivus has a large family, though," put in Big Paunch.

"The biggest family here, anyway," an adolescent boy with a cluster of angel-fair curls said, consideringly.

"The Dimmiches in Perialter have a bigger brood."

"Enough." Amber stopped what might have been a listing of all large families on Reflections. "Is the Gingivus house clean? Equipped with all the amenities?" A flicker ran through the natives, as though they all snickered though there was no sound but heavy breathing. "Appallingly inadequate but the best you—" She emphasized the single word with delicate scorn. "—can offer."

Beard, face blank, obviously not understanding, nodded.

Amber herself nodded briskly. "It will have to do, then. One of you comm—" Again, she realized that this was something they didn't even know of. She had read what she could on this world; it was pitiably inadequate, which was another reason she intended to come here. Knowledge is power. Never fulfill only two purposes when you can accomplish three.

"One of you will run to your village now, so that this Gingivus and his—" She was beginning to read their silences. "Her?" she asked, too patiently. Nods. "Gingivus and her brood can be vacated

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by the time I get there in the wagon."

Again the messages passed. Several of the natives glanced at the crates piled in the storehouse. Then the adolescent headed for the door at a fast trot.

"Run," Amber said sweetly.

He speeded up, and was out through the door, the hide folding away as he swept through.

Or had it moved before he went through?

Amber filed that one away. Apparent incongruities were often the key.

"The wagon?" she asked Beard, who seemed to be the leader.

"On its way," he informed. Then, "I regret, Lady Heiress, that we cannot get it here any faster. Hox are—" He shrugged. "—hox. They go at their own speed."

"Hox are animals?"

"Yes."

"I'll wait outside." Her nose wrinkled. There was a faint sickening undersmell in the room. The other scents had masked it, or perhaps it was growing, but whatever . . . she wanted fresh air. "One of you—you—" She pointed to Beard. "—will come with me, to answer my questions." The scent was stronger. Ugh. What she went through to—

"Has it occurred to you," said a voice she hadn't heard before as the man who had up to then been immersed in his unpacking looked up, "that if you have to do things you do not want to do, to force others to do what they do not want to do, that you are as much a prisoner to them, as they to you?"

Amber, for one of the few times in her life, was speechless. Not at what he said. At him. He was beautiful. Not in the polished, surgery-improved way of the males she knew, because feature by feature, except for his eyes, he was almost nondescript. But those eyes. Wide and serene and totally, breathtakingly lovely.

One of her bodyguards shifted, just a hair, male recognizing male rival.

This trip was not going to be boring at all!

* * *

Beard had called him Druid.

"I'll call you David," Amber stated. "You look like a statue my Original has. David. You have a look of it. Odd," she mused aloud. "You don't look *like* it, but—somehow—" A look of beauty, innocence—serenity—

Druid—David—smiled gently. *You're beautiful*, said his eyes.

"You can be my guide while I'm here."

"No-oo," said a soft voice from inside. Braids, Amber thought.

"Three weeks," somebody else inside muttered.

That's right, dear, Amber thought smugly. You can have him back in three weeks.

The sun went down with a splash of light. For a second, David, his back to it, glittered. Almost she saw a slim silver figure that was only vaguely humanoid.

She blinked. David. "Tell me about your world," Amber purred, ignoring (though noting) barbs of jealousy from the two guards. If either of them showed it openly she would—

David's head turned. She heard a slight clopping noise, as though a clumsy mechanical were plodding over real-wood.

One of the guards sucked in breath.

Amber herself blinked.

Was this her . . . *transportation?*

It was drawn by a pair of four-legged animals designed by a drunken, probably delicensed gene surgeon, and it seemed made of woven-together bits and pieces. A man sat on a platform in front, controlling the animals.

In a way, despite its ricketiness, it was lovely. Some of the pieces—shells?—were round, except one side that came out in a smooth ellipse, pearlescent pastel rainbows that wavered with each movement.

Amber nodded, not realizing that a pink tongue had come out to lick her lips.

The product she was looking for.

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Natural. Even if a synthetic could be programmed, could be infinitely more versatile or appealing or whatever, natural still had a cachet. If it had to be imported, with immense fees . . . her mind totted up, smiled and rubbed metaphorical hands. For that importation. . . .

The shells, or whatever they were, might be common as dirt here. Why else use them for this falling-apart wagon? But imported in small numbers?

Oh, yes, the Original would be proud of her for this coup. Her mood skin glowed burgundy.

"Nothing in the Universe is more important than your satisfaction," David murmured.

Definitely, not a boring three weeks.

After she'd settled in, Beard came and asked if there was anything she wanted. There was desperation in his eyes, a sheen of sweat on his forehead.

Amber smiled and said she would let them know, as needs occurred.

And waited blandly.

Beard cleared his throat. "We—ahh—we don't have off-world visitors often," he said hesitantly.

"I know." She gave him another third-best intimidating smile. "I'm making allowances." Implication: I'm getting tired of making allowances.

His eyes flickered sideways. She felt she could almost draw a straight line to the warehouse, with its pitiful collection of crates.

"We—" He cleared his throat. "Your customs may differ."

She raised her brows, rather, the area where her brows had been. She had had them depilated, and tiny holders for works of living art implanted. Currently, Picassoids. "*Your* customs differ," she pointed out, allowing boredom to hoarsen her voice a little.

He flinched, tried again. "I wouldn't presume to advise you."

More boredly: "Then don't."

Desperate: "He's married." Hastily: "*All* our men are married."

It took a few seconds for it to sink in. Then she couldn't help herself, training or no. She started laughing.

He got red and then redder, the tips of his ears, sticking out of all the hair, looking like you could warm your hands at them.

"Scum," she said, when she could catch her breath. "I forgive you this once, for your ignorance. But next time . . ."

He opened his mouth, saw her gaze on his tongue consideringly, and hastily said, "Whatever you please, Lady Heiress."

The Original had trained her well. She didn't *ask* about the shells (or whatevers) the first few days. She just complained about her quarters, walked around looking and chatting idly, enjoyed David, and made her mental notes.

The one flaw in David quickly became clear.

He had no mind.

Oh, he was clever with his hands. After Beard (he told her his name was Renswillow, but she thought of him as Beard, and it was getting ratty from his chewing on it) begged her sweetly, she allowed him the loan of David to help install the equipment they had received.

She was content to watch him, his hands stroking the smooth metal/synthi machines almost the way they stroked her.

But he didn't talk.

No. He talked occasionally, as he had spoken to her.

But what he said—

Odd aphorisms, like that nonsense he had first greeted her with. Sentences that sounded like they ought to make sense but didn't.

Never did he simply respond to what was said to him, never answer a yes or no, always either silence or one of those . . . those pronouncements of his.

Nothing in the Universe is more important than your satisfaction.

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He could say that as often as he wished.

And prove it.

Within days, she was considering taking David on with her. He was not a bodyguard, or conversationalist, not a wit, not anything but a marvelous stud.

Perhaps a present for the Original?

The Original would say, a stud is a stud.

Was David unique enough to please her?

Was David unique enough to last with Amber herself?

No matter that David's mechanical skills were desperately needed on this world, but she disliked wasting money, and she dreaded boredom. Suppose he couldn't cope in a culture totally different from his own.

He probably couldn't.

She decided to wait for that decision. After all, if he couldn't hold her attention for the whole three weeks, then—

Oddly, one of the bodyguards developed a frantic jealousy of David.

Even more oddly, it wasn't the brunette, who might be the more threatened-feeling, since David was also a brunette, but the blond, who, knowing her penchant for variety, should have felt safe enough in his own talents, and the difference in coloring that should have prevented David from being a rival.

As the Original said, "Power unused isn't power. Period. Make everyone aware of your power. Always." Amber hadn't gotten to be Heiress by ignoring any of the Original's policies. Or even by not working on them, all the time.

David wore a small shell around his neck, dangling on a woven-hide strip. It had a silky attraction, not unlike his skin, and she found herself moving one finger round and round its concavity, when the rest of her was otherwise muchly occupied with David.

* * *

Gingivus's house was fascinating. There wasn't an item in it, not one, that wasn't handmade. Amber explored, while seeming only to glance idly about.

There were tablecloths, towels, sheets, hangings, all hand-woven, dyed in marvelous earth-tones, with splashes of vivid color, made more striking by the reticence of the major tones.

Every piece of furniture was hand-carved; you could see, feel, the strokes of ax or knife, despite the polishing, smoothing. Or if not the actual cuts, then the very lack of perfection, regularity, proclaimed hand-work.

Perhaps an interest in handmade could be rearoused? A market for the handmades, another for materials, fads, hobbies? Amber put it on her mental note pad. On civilized worlds, handmades were almost forgotten. Machine-made, programmables, so much more amusing. But time was money, and if a cachet could be attached to the handmades? There was the market for naturals already: realwood, tiger skin, mirmine.

This world might have many possibilities besides the shells. And only Amber had realized.

Braids' gaze was an almost palpable presence, whenever she was out with David.

And somehow, when she was inside, too.

They made a pretty couple, Amber thought. Maybe she would take him with her after all.

As the Original said, constant reminders are the most efficient.

Knowledge is power. Control. Manipulation. *Subtle* manipulation.

If everyone about you is engrossed in competing with each other, being jealous of each other, working on each other, while you quietly pull their strings—

She asked questions, of course. Boredly, as through the answers didn't matter.

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Mostly, she asked them of Beard, sometimes of Braids, or whoever was within reach. Most of the answers didn't matter, but she filed away the few that did.

The shells (though they called them *fillamer* [Beard] or *huuvin* [Braids], but she still thought of them as shells, not those stupid local names) were not as common as she had hoped. Everyone seemed to wear one, either around the neck, or woven into hair, or on a wrist. But other than that—

The buildings she saw were made of dried mud brick with mud mortar, larger chunks of possibly plant material, columns that were pieces of still-living whatevers, stone. There was no synthi generator that she saw.

But where the shells were used, they were used generously. Gingivus's house had none, but some of the buildings used them for window covers, or had them ringing the doorway or inside, used for various purposes.

They came in sizes from the cover-your-palm smallness David wore around his neck to the salad plate Beard had on the back of his jacket to almost half a meter in diameter. All were gorgeous, pastel colors flowing over a cream base as the light shifted. She imagined them used to embellish furniture, walls, as a frame for a holo screen, cut and carved to make jewelry, *objets d'art.*

Clothing. Strings of the smallest shells, of pieces of shell, hanging from the hips, clinking enticingly, swaying open and shut as the wearer moves. A similar collar, hanging over the breasts. Individual shells, cut in exotic shapes, stick-tited to the flesh. Woven into long hair.

Amber couldn't believe her ears. No one *ever* said No to her.

They were sitting in the main room of the Gingivus house. The shuttle was due back in three days. None too soon! was Amber's opinion.

She already had several samples of woven material, casually commandeered "for shade" or to protect her feet from the dirt, or the like.

But they weren't the important export. The shells were.

Now Beard had just refused her any.

"I must have misheard you," she said, oh so softly.

Beard wasn't fooled. He shuddered, and a wisp of auburn disappeared into his mouth.

"I *couldn't* have heard you correctly," she cooed.

"They're dangerous," he blurted out.

Amber didn't believe him. They were all over, these people used them all the time, for all sorts of purposes.

"To *you,*" he said, in a choked voice. "*We've* adapted, you offworlders haven't."

Her brows (Feinsteinoids today) rose slightly. But she had heard of odd adaptations. If the shells gave off some sort of poisonous vapors, or caused reactions by the touch?

Nonsense! She had been around them for almost three weeks, touched them, even.

"Three weeks is safe," he said. "Maybe longer. But not much. They—" Voice dropping, he mumbled something that sounded like "channel." If she believed him, so much for her triumph.

"You underestimate us. Perhaps they can be decontaminated."

He stared at her, eyes bulging.

Primitive! she thought contemptuously.

Then, not knowing why, *He's lying.*

She smiled, slowly, her best smile, and he, not understanding, thinking he had convinced her, smiled back.

The shuttle landed.

Amber was waiting in the building, with two bodyguards, one sullen maid . . . and David.

Beard didn't realize.

Then he did.

He howled like a pig getting its throat slit. (Amber had watched that interest-

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ing operation, added another to her list of amusements for her friends.)

David only stood casually, that *elsewhere* smile on his face.

Beard, frantically, when he realized he had minutes at most: "He'll *die* if you take him offworld!"

Amber hesitated. Not from concern for the man, but because of the money wasted.

"It works both ways, the adaptation," Beard said hurriedly. "Take him away, and—"

David was humming beneath his breath, his eyes focused somewhere between the two bodyguards.

Amber totted it, profits and loss. "I'll miss him."

Beard shuddered. "It would be the same for any of us."

"I'll miss *him*." Amber made it clear she hadn't been referring to a human substitute. "But perhaps—" She took a step toward David, hooked the neckband of woven strips and pulled his shell out and held it. "Perhaps—"

David smiled, but he was smiling through her, not at her.

"No-ooo—" Beard sounded like a dying man.

"A souvenir," she said sweetly. "A memento?"

"No!" Stronger.

The blond bodyguard moved forward.

"No." It was the woman Braids, this time with pale pink ribbons, almost invisible in the somehow subdued brightness of her hair. "No," she said with a sickly smile. "Such a small—" She swallowed. "—memento. Why not bigger ones? Why not—" Her hand gestured. "—one of the larger ones off the wagon?"

Amber pursed her lips. "But they're not *his*," she pouted, enjoying the distress they were trying to hide, her *control*.

"You can have mine instead, it has much prettier colors," Braids offered, pulling it out and showing it, somehow moving between Amber and David.

Beard moaned.

Superstitions, Amber suddenly realized. They're probably like those primitives who think their soul is stolen with a holo.

Her thumb stroked the inside of David's shell. It was almost like stroking bare flesh. Her thumb felt warm.

She could almost feel the impatience emanating from the shuttle. (Yes, she would have to do something about that bosun.)

She didn't want to take David if all she would get was a few nights of what any of her studs could supply.

She stroked the shell again, and David's hand came up and caressed her bare midriff.

There was a thud outside the building. Amber didn't turn, knew it was the landing ramp. Definitely, the bosun was high on the list.

She ought to take both shells *and* as many as she could detach from the wagon.

But: long term, the Original always said.

If she frightened them, would they hide all the shells the next time a ship came?

Probably. Primitives had odd reactions.

She smiled. "I wouldn't want to take yours," she told Braids sweetly, and watched the high color fade from her cheeks. "I would like his, but I wouldn't want you to be distressed, and you seem to be."

"Please," Braids said softly, her green eyes swimming with unshed tears.

"But I would like that memento," she said, still softly, but with pure iridium underneath. "Some of the shells, you call them *huuvins*, I believe, from the wagon."

Braids went limp, though she still stood, swaying.

"Plus perhaps some more shells later. I like the way you use them to decorate, and perhaps, in my own home, which is quite large. . . ."

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"But—" Braids started, then, narrow-eyed: "Dislink—*shells* like on the wagon? *Huuvins,* you mean? Lots of them?"

Amber smiled sweetly. "Many shells such as those on the wagon. I have a *very* large house. You will send many shells if I ask for them. Otherwise—" A look at David, his hand still moving on her skin. "I did so like him. I would miss him." The best piranha smile. "We have our skills. You fear overmuch for him."

Beard muttered something into his auburnness, now rattailed with chewing and saliva.

Amber smiled.

The shells were a great success.

The handmades a lesser one, but with more staying power.

The Original was pleased.

So was Amber.

It was a subtle change at first, so subtle she thought it was just boredom, or the after letdown of her triumph, or the strain (but it hadn't been before) of keeping up to the Original's standards under the Original's eyes.

It got worse.

The Original let her catch her checking out a pair of younger replicants.

A Warning.

It got worse.

And worse.

Until she was in an almost constant sweat, unable to enjoy, unable to think, able only to react to—to—she didn't know what.

But she could put her finger, finally, on when it must have started.

That last trip.

The Original would never send her on another Survey trip again so soon, but she was allowed some initiative. (If she hadn't demonstrated it at intervals, with profits, she would not have remained the Heiress.)

So she laid her finger (figuratively speaking) aside her nose and winked—and disappeared.

Traveling as Nile Patriz, with one carefully selected bodyguard, was completely different from traveling as the Matanzima Heiress.

But it was too trivial to bother with, now. Compared to the—whatever it was.

The guard was enjoying himself. He had never had the Heiress to himself. He might even have been dreaming dreams.

If so, she was too preoccupied to stop him.

Worlds ticked by. Nothing here. Nothing here.

She picked up enough ideas to excuse the trip—possibly.

But the problem continued to get worse.

She almost skipped Reflections. She had spent time, much more of it, on plenty of other worlds, after all.

But she *had* visited it.

And they *had* claimed the shells were dangerous.

(She still wore a selected one occasionally.)

It took a lot more arranging for someone not the Matanzima Heiress, but eventually she was walking down a ramp again, the single rainbow-columned building in the distance.

As usual, the natives were more interested in what was being unloaded than the people unloading. Or a passenger.

This time, she didn't wait until the crew had unloaded everything, but insisted on going down on the first cargo haul. So she simply walked down the ramp, bodyguard behind, and looked around at the bustle, until she spotted a familiar face.

Went over and tapped him on the shoulder.

Beard looked up and stared at her without recognition.

Time had passed and fashions changed. She had kept the mood skin,

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but very little else.

She didn't care. As soon as she put foot to ground, she had Known. Here. Something *here*.

"I want to talk to you." She was too tired for it to have the usual bark of command.

"Offworlder," he said with a shrug, "I'm busy. They only allow us a couple of hours to unload everything and move it away from—"

Between her teeth: "Take a good look at me, colonist."

He did. But it was Braids, perhaps a little more perceptive, perhaps feminine intuition, who put a hand to her mouth, gasping.

"I want to talk to you. Both of you. Somewhere private. Now."

"I don't—" Beard started, but Braids put a hand to his chest, and he stopped. It was the woman who said softly, "What do you want?"

"To talk. And—" Grinding her teeth. "I don't know. But I know it's your fault."

Without looking at each other, the two consulted.

"Only three weeks," Braids murmured.

"Not enough time," Beard agreed.

"But—"

Without looking at her, they examined her, in a fraction of a second.

"Oh *oh!*" Whatever they found, Braids didn't like it.

"We'd better—" Beard started.

"In private," Amber ground out.

Another message passed immaterially.

The crew wasn't paying any attention to the eccentric passenger, but Braids and Beard nodded at each other.

"Follow me." Braids turned, and the four of them strolled off, apparently casually.

"You said privately?" But Beard remembered how the bodyguards had shadowed her on her first trip.

"He stays," Amber confirmed. Then: "Where's David?"

The native pair didn't answer.

"Druid." She remembered his native name.

"He's not available."

Amber's temper flared. Cargo might be hidden, but not people. She'd come back and steal him off this world, danger or not!

Beard dropped to his knees.

Braids collapsed limply.

Amber herself felt such a flare of pain that she grabbed her midriff and doubled over.

"Whatever you're doing to her, stop this second, or—" growled a male voice.

Braids moaned. Beard writhed.

"Not them—" Amber managed to get out.

"Fix her!" the guard snarled, desperation thickening the menace in his voice.

"Can't—" from Braids.

"Relax—" from Beard.

How could she relax when she was in *pain?*

Then, miraculously, as though someone had been hit over the head and knocked out, the pain lessened, and she could think. Relax. As she relaxed, it got easier and easier. She stood up straight, heaving a sigh, and saw that Beard was scrambling upright, but Braids was completely limp, eyes shut.

"Explanations," she bit out.

"Relax," Beard said in his unaggressive voice. He sighed, sucked in a wad of auburn. "Over there." He pointed to a place where several smaller crates had been stowed, temporarily off the field, but not yet dragged to the shelter of the far-off building.

"Yes." She started over, bodyguard a pace behind, ignoring Braids, who had started whimpering.

This was it, though. The pain. It had been pain before, but so low-level she hadn't recognized it as pain, just as an unease, an itch in the back of her mind.

But this was it. Here. Pain.

Beard dropped to a crate with a weary sigh.

She glared down at him. "Well," she barked.

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"Easy," he flinched. "Relax."

She had felt it too. Again. Pain. Not as bad this time.

"Tell me."

"Relax," he looked up at her, his weak face smiling pleadingly. "Please."

She took a deep breath. The pain lessened and disappeared.

"Stay relaxed, for all our sakes," he said softly.

"Why?"

"I don't know. Three weeks shouldn't have been enough time—"

Braids staggered over, fell more than sat beside him. There was a bruise turning purple on her chin. More of those wordless messages passed, only this time Amber found herself picking up pieces.

Druid?

Must have, he was so close—

not enough—just him—three weeks—

linked channel?—

she didn't have one—

she touched Druid's—often, but it needs more—

—birth bond?—

—no—

"Freaks!" Amber said bitterly, and they both winced.

"Please," Braids said.

"No," Beard added. "Adaptation. What you call the shells were the beginning. Some of them. The live, linked ones. Channels."

"But once some of us bonded—" Braids took it up, as though they were two minds with a single thought train.

"It became easier to bond deeply, with other humans as well as—" That was Beard.

"The *dormulu*—" A vision of slim, corn-silk white humanoids. "—liked the flavor of humans—"

"—some better than others—"

"—but all humans on this world bond—"

"—and share—"

"But I haven't been on this world this last year," Amber objected. "It's stronger here, but I feel it everywhere." Normally she would never have given away such a vulnerability. But she was desperate. If this wasn't cleared up . . .

"Of course." That was Beard.

"The *dormulu* aren't greedy. Once they share, they leave the gift. The ability to share with others. All others."

"Happiness multiplied manyfold."

"And pain." Braids. "Humans have always had the capacity for empathy with others. The *dormulu* increase that until it's the ultimate sharing."

"But three weeks—" Beard again.

"She forged the bond with Druid." There was an underlayer of anger and satisfaction at the betrayer betrayed in that, and all three of them winced.

"It shouldn't have been enough," Beard murmured. "There had to be more, some other channel, something else that made her more . . . more receptive." But Amber didn't care how it had happened, just how it could be undone.

Her mood skin glowed green, and Beard gasped, and Braids murmured, "I thought it was just colors before." All three of them shared the knowledge. The mood skin had been the channel. Now she had the "gift." Totally. Growing.

"How can I be cured." It was a threat.

"You can't." Beard again. This time her sharing, or whatever it was, told her: He spoke truth.

Dangerous: "Which means?" Again all three of them flinched.

"You must relax," Beard coaxed. "You must control yourself, your anger, your pain, because those around you will share it. As you will share their sharing. If you cause pain in others, you will share it twicefold."

"The *dormulu* have their own sense of equity," Braids added.

"Some of us meld more thoroughly than others," Beard said. "But with all—"

Again the woman finished for him. "What's done cannot be undone. The *dormulu* are not . . . Indian givers."

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Total defeat: "But what can I do?"

"Leave before the bonding gets worse."

"Control yourself."

One of the crew called out to her. They were through unloading this batch.

"You can do nothing?"

"No." Again truth.

Amber turned, headed for the ramp, the shuttle, and the rest of a long, long life.

What you do will rebound on you twice-fold.

She had been trained, to an instinctive level, in controlling all those around her.

Painfully.

For the power of it.

All her habits, all thoughts, everything shaped to that one skill, controlling people.

Reflexively. For the others, painfully.

But people don't like control. They resent it.

She would feel their resentment as pain, their distress as pain, their impotent rage as pain.

All her life long.

Reflections. Reflexive. Reflexions.

But she had to continue.

Because she had made too many enemies. Fall from her perch—

She couldn't even try to jump instead of falling. Give everything up, stay here, or run and try to hide. She knew too much. If the Old Lady didn't try to get her, others would. Even here. Anywhere.

Her only safety was to continue as the Heiress.

Accept the ultimate challenge.

She shuddered, and straightened her spine.

Walked up the ramp.

Onto the shuttle.

And the lifelong task of controlling herself.

Behind her, Braids and Beard trembled at her reflected agony, none of which showed on the lovely face.

But it would soon be over . . . for them.

For her, it was just beginning.

But they had given her . . . something.

What could be the answer.

Control.

Control herself *first*.

Then . . . learn. Unlearn and learn. New ways to control herself. New ways to control others.

If the people around her, the people she bonded with were in pain, she would be in pain. If the people around her were happy . . .

Who knew, happy people might even prove more useful, more loyal, than terrified people.

She hoped so. Because if that was what she had to work with, work with that she would.

She was the Heiress. She had never backed down from a challenge.

She would learn. Then she would conquer. Whatever was needful.

Including herself.

They had entered the seating area, and the guard adjusted her seat, then waited for her permission to seat himself.

She smiled at him. Slowly. Not one of her intimidation smiles, but one she had to dredge back into early childhood for. A simple smile. I am content.

He blinked, then smiled back.

Triumph! She could do it. She would do it. She patted his arm, and nodded to the seat beside her.

The ultimate challenge.

She *could* do it. ■

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The Great White Way

Laura Frankos

Various forms of gladiatorial combat have long been used to settle all kinds of disputes—some of them, perhaps, a bit silly. . . .

Trina Hutchinson-McCoy chuckled as she unlocked the door to the studio office she shared with Brent Birley at YouAreThere Virtual Reality Gaming in Sherman Oaks. For once, she'd beaten him and earned the privilege of selecting the first CD of the day. When Brent did show up, venti Starbucks regular in his hand, clapping wood blocks and Oriental pipes reverberated through the room.

Brent paused in the doorway. "Oh, God," he moaned. "Not the Kabuki musical."

Trina looked up from her e-mail and grinned wickedly. "*Pacific Overtures* is my revenge for your playing 'The Little Engine That Could' yesterday."

Brent set his coffee down and booted up his computer. "*Starlight Express* is one of Lloyd Webber's weaker scores, but it's kind of kicky. Anyway, it was *meant* to be a children's show. *Pacific Overtures* is so brainy, you've got to be either a Ph.D. or a die-hard Sondhead like you to understand it."

"That's not true," Trina said. "You don't have to be a genius to love Stephen Sondheim. But you do have to appreciate the unexpected. You have to pay attention; you can't be lazy. That's why he hasn't been the huge commercial success your precious Andrew Lloyd Webber has been. Because audiences *are* lazy. They want the conventional, the comfortable."

"The hummable," Brent said with a gleam in his hazel eyes. They'd been friends for years; he knew how to push her buttons.

"If you can *sing* a song, you can damn well *hum* it! Sondheim—" Trina began hotly, then broke off. "I don't need to cite chapter and verse—or even song and verse. Sondheim's music is as melodious as any Broadway great's, even if he hasn't turned out popular standards. And God knows he can write better lyrics in his sleep than those hacks Lloyd Webber's worked with since Tim Rice. Rhyming 'calm' and 'warm' in 'All I Ask of You'!" She made a gagging noise.

Brent shrugged. "The character of Raoul is a wuss. You can't expect him to make good rhymes."

"That's no excuse," Trina said.

Brent examined the jewel box of *Pacific Overtures*. "I like Sondheim, but in

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small doses. I can love Lloyd Webber's shows, love them without restraint, see them and listen to them over and over. I've seen *Phantom* eight times, *Cats* six times, and practically worn out my video of *Evita*. As for Commodore Perry, George Seurat, cannibal barbers . . ." He shuddered in mock horror. "Who can love them but mad Sondheads like you?"

"How many times have we had this argument?" Trina asked.

"Hundreds. And we can never settle it. You say Sondheim's better, I say Sir Andrew's better. We're like kids in a schoolyard. Nyah, nyah, my guy's characters can beat up your guy's characters!"

Trina stared at him for a long moment. "That's it. That's what we'll do. We'll have them battle it out." When Brent looked perplexed, she patted her computer. "Let's set up a VR game like that Civil War reenactment or the Tolkien one you've been tinkering with for years, but with characters from Sondheim and Lloyd Webber's musicals."

"YouAreThere could never sell it. Imagine the copyright tangles."

"Quit being so commercial! This is art! I wouldn't offer this to Y.A.T. This is for bragging rights in this studio, for control of the stereo!"

"The whole enchilada?" Brent smiled. "Maybe. We'd have to establish the parameters."

"We can treat them the same way we've done any gaming adaptations from literary sources. The characters' abilities, intelligence, and weapons are defined by the plays they appeared in. I couldn't give a hand grenade to Franklin Shepard, the composer from *Merrily We Roll Along*. A piano, maybe, but no grenades."

Brent stroked his smooth dark goatee, his expression thoughtful. "So Alex from *Aspects of Love* could have a revolver, because he uses one in the show, but not an artillery piece."

"Right. That would as unfair as giving Robert E. Lee an AK-47. The shows themselves dictate what the characters can do."

"You know, Trina, this could be fun. What do we use for settings?"

"The locales of the musicals, of course. You get the Holy Land, Buenos Aires, Sunset Boulevard, and the like; I get nineteenth-century Japan, Victorian London, and New York City, naturally. And shweet-hart,"—Trina dropped into an atrocious Bogie accent—"we'll both have Paris."

"Ouch." Brent winced. "But you have an unfair advantage: Sondheim's older than Lloyd Webber. He's done more shows, so you'll have more characters to draw on."

"This is my fault?" Trina tossed her auburn curls.

"You've always said you felt Sondheim on his own was better than Sondheim writing for someone else's music, so I think you should limit yourself to the shows where he was both composer and lyricist."

"Oh, all right. But I confess I was looking forward to Mama Rose and Evita arm-wrestling."

"God, the possibilities in this!" Brent raised his coffee cup in a toast. "You've got an evil mind, Katrina. I can hardly wait to get started!"

Trina grinned. "It is a depraved notion, isn't it? But you have to treat this the way you do your Tolkien project: work on it *strictly* during non-office hours or Mr. Dobashi will nail you to the wall."

"I'm careful, I'm always careful." Brent slid into his chair. "Though it's not as if you have to worry about the boss. After improving the system's AI last year—the integration software, speeding up the fuzzy logic links—you're delightful, delicious and de-lovely in his eyes, to quote Cole Porter."

Trina was already downloading the schematics for YouAreThere's latest project, a virtual reality adaptation of *Alice in Wonderland*. "You know damn well I

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never could have come up with all that without your help. And I told Dobashi so, loud and clear." What Brent didn't know was that she'd refused her promotion unless Dobashi advanced him as well. Dobashi didn't cave in at first, which had led to some bitter arguments in her household. Trina's husband Bill didn't feel she should let anything, even workplace injustice, stand in the way of career advancement.

"We worked as a team on the integration software," Trina said, "and even though I fiddled with the fuzzy logic links, it was all because of a chance remark you made that made me look at things in a different way. That's why we work well together."

Brent smiled at her. "Well, I appreciate your kind words, even though I still think you did all the hard work. I was flabbergasted when we got our own private studio. Soundproofed, no less."

"Oh, that." Trina waved her hand at the walls. "I hear the whole staff chipped in to give us the studio just so they wouldn't have to listen to us playing showtunes."

"Or arguing about them!"

They settled down to working on the Cheshire Cat, determining whether to let its image flicker in and out randomly or to allot a portion of the AI to the Cat's program so it would disappear and appear in response to a player's words or actions. As they debated the matter, *Pacific Overtures* concluded.

Brent wandered over to their collection of musicals to make the next choice. "If we're going to create the world's first Broadway musical war game, I think we should agree not to play any Sondheim or Lloyd Webber while we're at work. Too distracting. I can picture myself, trying to work on the Cheshire Cat program, but thinking about a VR Macavity the Mystery Cat instead."

"Certain amount of similarity between those two felines," Trina said. "Lord, you ask a lot! Months with no Sondheim in the studio! I'll go into withdrawal."

"Get Bill to take you to the twenty-fifth anniversary production of *Sweeney Todd*," Brent said, deadpan, for Trina's husband barely tolerated musicals. "It's sometime early in '04; saw it in the *Times*."

Trina snorted. "Bill? Bill who? I've hardly seen him since basketball season began last month. He and his brother got season tickets to the Lakers. Shaq's final season or something like that. Are you going to put a CD on or not?"

"Do you agree to the moratorium?"

"Yes, you cruel man."

Jonathan Tunick's lush orchestrations for the 1996 production of Boublil and Schönberg's *Martin Guerre* floated through the state-of-the-art speakers as the two friends returned to the Cheshire Cat.

Trina soon decided the musical war game was one of the most enjoyable projects she'd ever worked on. "Think of it," she told Bill at dinner several weeks after she'd proposed the game, "forced to listen to Sondheim! What exhausting research." She pretended to slump over her plate.

"Yeah, life's rough," he said. "But I still can't figure out why you're doing this. Who would want such a crazy game? Could you ever sell it?"

"Of course not. It's just something silly that Brent and I are doing."

"One of his squirrelly ideas, if you ask me." Bill sawed at his Cornish game hen, ripping off a leg and thigh with the same precise attention he used when crafting orthopedic appliances. "It's pointless."

Trina fought down a wave of irritation at his dismissive tone. "As a matter of fact, it was my idea. Look: it's like the endless arguments you have with Patrick about who was better, Magic or Bird, Babe Ruth or Mark McGwire, the '27 or the '98 Yanks. You have computer games that let you simulate matchups that never occurred in real history; we haven't got anything like that. There's

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no way Brent or I can say Lloyd Webber or Sondheim is better, though we hurl lyrics at each other and cite Tony awards and length of show runs. So, just for fun, we'll make a strategy VR game of it."

"Seems to me you're wasting time and energy you could channel into something profitable."

"There's more to life than profits. Besides, with every VR adaptation we do, we learn things we can carry over into the next project. And it's *fun*, Bill."

"However you get your jollies." Bill dumped his plate and glass in the sink. "Mind if I leave the dishes? I have to pick up Patrick and that'll add twenty minutes to an already hellish drive."

"Sure."

After Bill left, Trina cranked up the stereo and continued wallowing in Sondheim albums. She'd never play musicals that loud when Bill was home, nor would he play his jazz albums at a volume that disturbed her. But with him away . . .

She washed dishes to the thundering *Dies Irae* chords from *Sweeney Todd*. She looked forward to seeing the demon barber skin some of Lloyd Webber's cats. She also intended to alter Brent's Gandalf program for the witch from *Into the Woods:* hoisted by his own petard! And how could he defeat a solid core of successful presidential assassins? He didn't have a chance.

But Trina realized other Sondheim shows would be harder to adapt to a war game. She quickly dropped the aging showgirls of *Follies*, the frenetic New Yorkers of *Company*, and the mad Cookies of *Anyone Can Whistle* from her plans. She needed firepower to blow Brent's Webberites from the terrain, big-time firepower.

She was still hard at work when Bill came home from the Laker game.

Crafting the VR wireframe skeletons and draping the bodies over them took several months, but was relatively easy. She used the same software she and Brent had devised for other games at YouAreThere, and designed the features and clothing appropriate to each character. For Sondheim's musicals that had been filmed, she had ready-made cheats. She simply scanned the video images of the characters and molded them to the 3D frames. It was harder for works like *Assassins* and *Pacific Overtures*, where she had to start from scratch. Trina found herself lugging home so many reference books from the library that Bill jokingly asked her if her degree was in history, not computer engineering.

The biggest challenge came when she began programming the characters' "brains." She and Brent would each start with the same amount of AI, to divide among their players as each saw fit. The key to a successful team was to have a well-developed leader, but to reserve enough AI for the supporting cast. She gave Sweeney Todd, her captain, the largest portion of AI. Two sets of ordinary soldiers—one Roman, from *A Funny Thing Happened on the Way to the Forum* and one of samurai from *Pacific Overtures*—got minimal amounts. They didn't need to think well; their job was to bash heads. In between those two extremes lay the rest of her team: a array of weapon-wielding characters from a trio of assassins to Georgio from *Passion*, a soldier who took part in a duel. After much thought, she decided to add George Seurat from *Sunday in the Park With George*, more for the fun of creating a VR Mandy Patinkin than for any other reason. Trina had always thought Patinkin had soulful sexy eyes, rather like Bill's.

As winter continued, Trina encoded her characters, creating hundreds of scenarios and devising appropriate responses for them. It was painstaking work, but she had to cover as many options as possible. Brent specialized in outlandish schemes, so she didn't want to be caught by surprise. "Still at it?" Bill asked one night before heading out to

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pick up Patrick. "Aren't you ever gonna finish?"

Trina looked up from a stack of librettos. "Eventually. Sometime next summer. If I'm going to do this, I'm going to do this right. Brent's going slowly, too." She giggled. "I wish I could write some ersatz Sondheim lyrics, just to drive him nuts."

"If he retaliates, he'll clean your clock. Wasn't he raised on Broadway? He plays the piano better than anybody I know."

"Uh-huh. Both parents were violinists on the Great White Way, and his aunt's a concert promoter married to a theater manager in London. He's got lots of connections and he's seen shows I've only dreamed about. He was classically trained, but wasn't quite good enough to make the bigs, as you'd put it, so he went into computers. Even did some acting at Cal Tech and a couple of small local theatres."

"What happened to his girlfriend? The one with that amazing figure?"

"Danni? I have no idea. After she dumped him last year, I prayed her miserable sitcom on that cheesy network would be canceled. And lo! There is a God! Or at least Nielsen ratings."

Bill jingled his car keys. "I better go. Don't wait up for me; they're doing some promotion at halftime, so the game'll run late. Have fun with your musicals."

"Don't worry; I am."

She meant it. She loved the challenge of bringing Sondheim's people to virtual life. She'd been singing along with some of these characters since she was a child; others she'd met as an adult, most of them in Brent's company. She remembered the time they first watched the video of *Passion*, how excited they'd got over the audacious score of *Assassins*, how much they enjoyed the twentieth anniversary production of *Sweeney Todd* in '99, with Kelsey Grammer in the title role and Davis Gaines singing the part of Anthony in his gloriously sweet voice that made Trina want to melt.

What Trina couldn't tell Bill was that the worst part of developing the game was *not* being able to do it with Brent. They'd become friends in grad school when they discovered their mutual interest in musicals and computers. Brent was married then, first in a long line of what Trina considered highly inappropriate girlfriends. Watching them come and go, she sometimes felt like Robert's friends in *Company*. Of course, when Bill entered her life, Brent hadn't cared for him, and vice versa . . .

When Brent joined her at YouAreThere four years ago, what had been pleasant work turned into so much fun it seemed indecent that she was getting paid so well for it. The way their ideas meshed made working on the musical duel alone even more agonizing. She accepted that Bill's interests lay elsewhere, but it hurt when she slaved to recreate that street in ancient Rome from *Forum* and had nobody to show it to.

Well, Trina thought, *Brent will eventually see it, when we have our duel and my Sondheads trounce Sir Andrew Lloyd Windbag. I'll just have to wait till then.*

Whatever Brent was doing for his team, he kept strictly to himself. The only time either of them broke the moratorium on Sondheim-Lloyd Webber material was one morning in late February when Trina got to work early and, as usual, found Brent already there. He was listening to *The Phantom of the Opera,* and made a face at her as she entered.

"You're here too damn soon," he complained. "I'm trying to do some work."

"Too bad." She nodded at the CD player. "That's the Canadian cast album, isn't it?"

"Yup. I like Colm Wilkinson best, but I know Michael Crawford's your favorite Phantom."

"Wilkinson's a more commanding Phantom, but Crawford's more seductive and tragic, which I think is key to

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the role. But Gaines makes a helluva Phantom, too: anguished, heartbreaking, and positively swoonful."

"Robert Guillaume was great, too," said Brent. He removed the CD and put it away. Squatting on his haunches, he looked up at her. "Damn, but I can't wait to show you what I've cooked up for this game! It's been maddening keeping my mouth shut for so long."

"Ditto. But it'll be fun trying to outwit you, especially knowing how your devious mind works. Any idea when you'll be done? I'm thinking July."

"Sounds about right." He dropped *The Music Man* into the player and they both returned to the virtual Alice game, for which they actually got paid.

When Trina walked into their studio on a cold drizzly morning in March, she wryly reflected that it marked the first time she'd beaten Brent in since the morning she proposed the musicals duel. Of course, it was a quarter to five, early even for Brent.

It didn't matter. She couldn't sleep, and didn't want to stay in the house any longer. *Might as well get some work done*, she'd thought. The game had reached the stage where she could concoct test cases for her characters. She put on the VR helmet, stretched out in the chair, and booted up her virtual Sweeney, George Seurat, Witch, and assassins. They shimmered a moment, then took form, standing before her in a line—a motley crew indeed.

She couldn't look at them dispassionately. They *were* good. Sweeney's pasty white face and frightful hair, the Witch's sparkling purple dress, Booth and Guiteau in correct period attire—all perfect to the last detail. And then there was George Seurat, looking at her with those beautiful brown eyes she'd labored over. Eyes that reminded her too much of Bill's. Her fingers fumbled for the controls; she'd delete the George program and incorporate his AI into Pseudolus and Oswald . . .

Her players vanished in a blaze of white light. For a horrible moment, she thought it was either the end of the world or that she'd deleted the entire game. The former seemed more welcome than the latter. Then the padded, soundproofed walls of the testing room came into view and a firm hand gripped her shoulder. "Katrina?" Brent was shaking her. "What the hell are you doing here at this hour?"

"Working," she snapped. "And you're interrupting me."

Brent reached towards her and gently removed the helmet. He let his finger brush her reddened, swollen cheek. "I refuse to believe you've been crying over the way *Sweeney Todd* ends, not after all these years. So why not tell me what's *really* going on?"

"Bill left me."

The words hung in the air. Brent stepped back, but then seemed to judge that the only other piece of furniture in the room, the second testing chair, was too far from Trina's side. He slowly sank to the floor and sat cross-legged.

Trina savagely twisted the helmet's cables as she talked: "He's been having an affair for the last two years with the older sister of one of his patients. Remember Andrea, the perky little brunette in red at his office Christmas party? She's pregnant, and they want to make it nice and legal.

"I should have known something was up when he said so little about the Laker games I thought he was going to. Last month, I saw on the news that Shaq smashed a backboard into a zillion pieces. Naturally, I mentioned it when he came home. He looked at me blankly, then mumbled something about missing it because he was in line at the concession stand. God, what an idiot I am! And don't say 'I told you so,' Brent! Just don't say it!"

"I wouldn't dream of it. I'll do whatever you need. You know that."

"He dropped the bomb on me last night, along with a load of guilt about

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how it's really my fault because I'm always so wrapped up in my work! Well, maybe there's something to that: I've had more fun with my Sondheads the last few months than I've had with Bill." She laughed ruefully. "Wrapped up in my work, ha! I admit to loving what I do, but it was always Bill urging me to take on more projects, nag Dobashi for overtime and better benefits, push for promotion. Without him, I'd be just another easy going, laid-back techno-dweeb."

"Like me."

"Hey, there are worse role models, believe me." She managed a smile. "A small voice in me keeps saying, 'It's all for the best,' but the rest of me is stunned. Anybody get the number of that eighteen-wheeler?"

"Been there, done that," Brent said in dull tones. "Listen, Trina, about our musical war game. If you want to drop it, I understand. I mean, if you feel it has some connection to what happened and that bothers you . . ."

"Hell, no! I've put in too much time to quit now. Maybe I would have cottoned to what was going on earlier if I weren't playing with my Sondheim characters, but he'd been screwing this bimbo for a year and a half before I challenged you. There's no cause-and-effect, however much Bill wanted to make me think there is. Considering what just happened and how it happened—Bill never was very tactful—I'm glad to have something to occupy my mind."

"Do you want to work some more, then?"

"No, I'd like some breakfast. Cholesterol and calories and coffee. Speaking of coffee, where's yours?"

"I was driving to Starbucks when I saw the light in the office and your car in the lot. Curiosity overcame my need for caffeine, at least temporarily. Come on, I'll drive."

With Brent's help, Trina found an apartment in North Hollywood, close to the YouAreThere office and ten minutes' drive from his own place. An ungodly amount of her time was taken up with the minutiae of putting together a life without Bill: car registrations, insurance forms, bank accounts, and those uncomfortable meetings with the divorce attorney. But those were commonplace, ordinary inconveniences. They had nothing to do with the relentless "could'ves, should'ves, and would'ves" that marched through her brain in the wee smalls. The notion of Bill's girlfriend having his baby was particularly galling. She suspected Andrea had gotten pregnant to force the issue; Bill always looked for the easiest way out, and probably relished carrying on with both wife and mistress as long as possible. Trina and Bill had talked about having kids, but he'd emphatically wanted to wait until '05, when he would take over his uncle's clinic. Trina had been a little reluctant—she was thirty-seven—but she'd agreed. Now, though she was delighted to have only paper and legal encumbrances tying her to Bill, that child-who-never-was kept hammering at her mind. *It's just as well*, she told herself fiercely. *No child should have such a liar and cheat for a father*. That Andrea's baby would indeed have that liar and cheat for its father was something she studiously ignored.

The Sondheim-Lloyd Webber war game, a creation all her own, became her safe haven, her refuge. She hammered out scenarios, programmed and reprogrammed movements so the characters' slightest gestures were fluid and natural, spent hours recording dialogue and song in a variety of accents and synthesized voices. One of her professors from Cal Tech agreed to record several of Booth's speeches in his soft Southern drawl. Other voices she reconstructed from albums and videos.

The George Seurat simulation stayed on her team. Taking a 360-degree virtual circuit of him as he stood painting and humming, Trina was glad Brent had in-

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terrupted her before she jettisoned the program. Her George was a fine bit of work, right down to his ridiculous phony beard, just like the one Patinkin wore on stage. Yes, her virtual George still had those sexy eyes that reminded her of Bill's, but lots of guys in the world had sexy eyes. No reason to ignore all of them, even the virtual ones, because of one louse.

Not surprisingly, given the time she was investing in the game, Trina finished ahead of schedule in late June. Brent completed his program several weeks later. The confrontation came on a Sunday, when they had the entire office to themselves.

Trina sauntered into the testing room, singing "I'm Still Here" from *Follies* and clutching her CryptoCram disks. Brent barely looked up from his monitor. "Prepare to accept defeat graciously," he said.

She loaded her first disk into the changer. "Don't be silly. I'm gonna mop the floor with your Webberites. Having problems already?"

"A start-up glitch. Happened to me at home, too. I'll be a minute."

Trina's computer played the arpeggiated chord that opens *Sunday in the Park with George*, her chosen signal that the VR program was ready to launch. Walking over to take her seat, she noticed a canvas bag next to Brent's chair. "What's that?" she asked.

"Two weeks' dirty laundry. My washer's busted, and I've been too busy to go to the laundromat. Why do you think I'm wearing black dress slacks? All my other pants are so filthy, they could be new life-forms. Touch the bag at your peril."

"Ugh. Sorry I asked." She slid into the chair, put on the helmet and palm control, and adjusted the volume control. Y.A.T. had improved their helmet design in the last two years: it was more like aviator's goggles with headphones than the claustrophobic helmets of old.

Brent plopped into the opposite chair. "I *think* all systems are go."

Trina jabbed the access button on her palm control and the testing room vanished, to be replaced by the crowded, gloomy forest from *Into the Woods*. Having lost a coin toss the day before, she opened on the defensive and selected the initial locale. Her first players appeared: the wolf, Mrs. Lovett, her samurai, Lee Harvey Oswald, and the hot-tempered Count. She intended to start conservatively, saving her stronger characters for later.

"Damn!" Brent said in her ear. "Another bug. Let me reboot."

"Tsk, tsk," Trina scolded. "This isn't like you, Brent. Are you nervous?"

There was no answer. Brent must have removed his helmet to tinker with his program. Trina waited, admiring the way the samurai's swords gleamed, how the wolf's tail twitched.

"Back again," Brent said, several minutes later. "Ready to rumble."

"No, you said I couldn't use *West Side Story*," Trina joked. "Let the game begin!"

As she spoke, her virtual self joined her small team. Their goals were twofold: to kill or capture the other team's players and to find three hidden objects. Trina's objects were a meat pie, Kayama's bowler hat, and Rapunzel's hair. Brent's included Joseph's coat, the cigarette case from *Sunset Boulevard*, and Christine's music box. She and Brent would virtually accompany and guide their teams through the game, though they themselves carried no weapons and could not be "injured" or "killed." Brent's comment was, "We want to stick around to see the end!"

Trina looked around the woods. Freed from the limitations of the stage production, she'd spread the forest over several miles, with cottages scattered here and there. The first object, the meat pie, was hidden in Red's basket, in Granny's house.

"Something's coming," the virtual

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Count announced.

Trina stifled the urge to repeat her crack about *West Side Story*. The Count was right: she heard twigs breaking. Suddenly, a striped cat poked its head around a tree, followed by several more. The woods seemed alive with felines.

The wolf sprang. The cats fled in all directions. One plump puss was too slow. The wolf shook it like a dishrag, breaking its neck. He dropped the furry corpse and pelted through the trees after the others. The seven samurai followed. Trina held the others back. "Wait," she said. "Go cautiously. There's a clearing near the baker's house."

"Just as well, dearie," said Mrs. Lovett. "I'm afraid them pussies is too quick for the likes of me."

As they progressed, they heard fearsome yowls and hoarse Japanese cursing. Trina and the others peeked into the clearing. She liked what she saw: shredded jellicles everywhere. The wolf licked his bloody chops. Trina's sole loss was one samurai, who had had his eyes scratched out by a pair of striped cats. "I have failed you," the blind samurai announced before committing *seppuku* by stabbing himself with his dagger. *Sometimes,* Trina reflected as he keeled over, *my programming is too damn authentic for my own good.*

"One of ours for eight of theirs," Oswald said. "Not bad."

"But the woods is still full of cats," Mrs. Lovett said. "Look! Two of them were hiding in the baker's house! They're going that way!"

Oswald smoothly raised his Mannlicher-Carcano to his shoulder and nailed one of the fleeing pair, but the other got away.

"Damn," muttered Trina. "Now they know the meat pie's not in that house. I want the wolf and the samurai to head east and cut them off before they reach Granny's house. The rest of us will swing around the other side of the woods."

To Trina's delight, her group soon trapped a squad of cats against a thicket near Jack's cottage. But before Oswald and the Count could fire a shot, something loud and metallic came charging through the thicket, ripping up the shrubbery: the steam engine from *Starlight Express*. One of the cats was riding it. He waved a paw, and the others leaped aboard. Mrs. Lovett threw her knife in vain, and the two men blazed away, but only two cats took hits.

"I really *hate* those trains," Trina said. "Considering where those cats were, they've probably already searched Jack's house. Let's try to meet the wolf and the others."

They plunged on through the woods, though they had no hope of catching the speeding locomotive. To make matters worse, they heard the wolf howling in agony and soon saw flashes of fire up ahead.

"What's going on?" the Count said.

They found the wolf and the samurai lying in the path, burned to a crisp. "What could have done this?" Mrs. Lovett asked, twisting her hands in her apron.

"The enchanter cat," said Trina. "I forgot he can shoot fireballs. Come on. I've planned this round badly; I never figured Brent would use kitties as a reconnaissance force! Let's head for Granny's house."

Mrs. Lovett never made it. A fireball exploded through the brush, and she baked quite as nicely as in the real stage show. The Count fired his dueling pistol at the flame throwing cat, giving the Sondheads their first major victory of the day when the feline toppled to the ground.

"Too late," Brent's voice said in her ear. "We've found the basket, and Bustopher Jones just ate the meat pie. This round to me, I think."

The following rounds teetered back and forth. Trina's Roman soldiers from *Forum* battled the Roman soldiers from *Jesus Christ Superstar* and won because Miles Gloriosus was a better leader than

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Brent's nameless centurion. That skirmish let the witch from *Into the Woods* find Joseph's coat, hidden under the table of the Last Supper. Unfortunately, Miles Gloriosus and his men fared badly against the Peronist goon squad. The goons were on the verge of overpowering the Sondheads until Lee Harvey Oswald assassinated Peron and Evita. He seemed thrilled at the chance to shoot at real fascist swine. Deprived of their idols, the goons melted away.

Jack the Giant-killer got run over by the steam engine, but a well-placed shot from assassin Charles Guiteau punctured the engine's boiler. Trina cheered when it blew up.

In the sixth round, the silent movie queen nailed the Count in Pharaoh's palace and burst into song:

With one shot
I can drill your heart
With one shot
Blow your brains apart
I can make your guts spill out
With one shot you'll find
You've left life behind

Trina hated losing the Count, but she activated the link and told Brent, "My sincere compliments. Better lyrics than Lloyd Webber usually gets."

The Sondheads soon took their revenge. Trina was defending once more, using the mansion from *Night Music*. She sacrificed handsome Georgio from *Passion* to lure the aging movie star into the dining room, where Pseudolus had prepared the drinks. As she'd hoped, Brent's programming was as thorough as her own. The mad actress immediately poured herself a celebratory drink. "To my comeback!" she announced, downing it.

Pseudolus's round, pop-eyed face appeared in the doorway. "Peek-a-boo!"

She put the glass down with a careful, deliberate motion. Then, in a voice throaty with passion, she said, "Oh, darling!" Lust in her eyes, she hurried after the pudgy slave.

There was a long pause. At last Brent spoke, his voice full of suppressed laughter. "I figured it was poisoned chrysanthemum tea. But you used the love potion from *Forum*, you sick puppy. Oh, well, I hope they'll be happy together."

The later rounds got nastier, as they both brought out their own serial killers. Sweeney Todd easily dispatched Joseph's brothers, St. Peter, and the remaining cats, though the bloody-handed convict from *Whistle Down the Wind* put up a struggle. Meanwhile, the Phantom's Punjab lasso worked its way through the Sondheads' ranks. Trina cringed when she lost Oswald and the Witch, two players with plenty of her precious AI.

Thinking about the AI got Trina wondering what Brent was up to with his own players. After killing or capturing an opposing character, it was possible to access its program, see how much AI it had, and evaluate what the opponent had left. Trina was shocked to learn how little AI Brent had given the characters her players had vanquished. He kept holding a huge amount in reserve, but where?

She suspected it lay in the Phantom, whose figure was yet to be seen clearly, though Brent kept cuing Michael Crawford's maniacal laughter every time another Sondhead was strangled. Trina got sick of hearing it.

The tenth round opened with both sides tied at two objects (Joseph had found the bowler hat in Marcus Lycus' house before getting his throat slit; Sweeney had found the cigarette case at the bottom of the swimming pool on Sunset). Trina's remaining characters were Sweeney, Guiteau, Booth, and George, who somehow hadn't got blasted or garroted. Pseudolus was lost to her; he was still with the reclusive movie queen, and Trina didn't want to know what the AI had decided they were doing.

Brent still had the Phantom, a Parisian

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gendarme, the incomparable English valet, and at least one other figure, who, like her George, had yet to take part in any action, but lurked on the sidelines. The Webberites, defending this round, had chosen the Paris Opéra House. Somewhere within its confines lay that damn music box.

The Sondheads stood at the theatre door, surveying the rows of seats and the stage. Trina pointed upward. "Listen to me, boys. *Stay away from that chandelier.* The guy in the white mask is aching to drop it on somebody. Let's search the dressing rooms backstage. One of them will have a mirror you can step through that leads to passages underground. That's where our clever Phantom lurks."

"There is a lake below," said George. "Or so I've heard."

"That's right. This won't be easy."

As she spoke, shots rang out from the direction of Box 5. The Sondheads ducked for cover behind the plush seats and rococo pillars. Trina got a glimpse of the pistolman: the hapless gendarme. True to his stage form, he wasn't a great shot; Brent, relentlessly honest in his programming, did not give him a sniper's skills.

Trina pumped her fist in the air when Booth, who knew all about shooting guns in theatres, plugged him through the brain. "Every day a little death!" Trina sang mockingly. Then her world went black.

At first she thought it was a glitch in the VR program. Then she realized she could hear water lapping quietly and see faint lights flickering in the distance. The darkness lifted enough to reveal swirling mist and candles everywhere. She was in a small boat and there was the figure of a man above her, punting silently. He turned and looked down at her . . . and Trina knew where Brent must have loaded all that AI.

He'd recreated Crawford's Phantom in painstaking detail. The black, broad-brimmed hat of fine beaver felt, the rich silken cape, the cold gleam of the white mask, the strong, outthrust chin—everything was perfect, including the mismatched lenses of white and dark blue. Trina could tell the layering of the physical figure was complete as well. If this Phantom took off his hat, she'd see his hair. If he removed his mask, she was certain it would reveal the distorted features.

Abducting her wasn't strictly within the rules. After all, as team leader, she couldn't be hurt or killed; the Punjab lasso was no threat to her. She decided to relax and enjoy the ride. Maybe she'd eventually figure out what crazy game Brent was up to with this sideshow.

Then the Phantom began singing "The Music of the Night" to her and she forgot about ulterior motives, except to wonder briefly why Brent had chosen Crawford as his model, and not his favorite Phantom, Wilkinson. Though she was a true blue Sondhead and well aware of the flaws in Hart and Stilgoe's lyrics, she'd always admitted the Phantom oozed sensuality. Now, having all that rich romanticism directed straight at her was almost overwhelming. She broke out in goosebumps, though the VR testing room was kept at a comfortable seventy-eight degrees.

As he sang, the Phantom guided the boat to the landing by his lair and gestured for her to disembark. She did so, gazing around her. Brent's loving attention to detail was evident in the gloomy, richly furnished rooms, from the heavy portcullis to the ornate mirror and massive pipe organ.

Then the voice changed from Crawford's rich tones to a less professional, more reedy tenor. The lyrics, too, were unfamiliar: a song of loneliness and desire perfectly in keeping with the Phantom's character. Trina felt certain if Christine had heard the Phantom address her like *that*, she'd never think twice about Raoul.

During the final verse, the Phantom

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moved closer to Trina's virtual self. He reached for her virtual hand and sang, "Trina, I love you."

To Trina's surprise, she felt cold fingers grasping her *own* hand and pulling her out of the testing chair. VR gaming was still primarily a visual/aural experience, though sensory gloves existed for some games. A few companies had developed extremely expensive body suits—rumor had it they were concentrating on perfecting VR sex—but the programs to run them ate up huge amounts of RAM. Undoubtedly, it would be a few more years before VR became more tactile.

Yet here was the Phantom of the Opera, wrapping his arms around both her own body and her virtual form. After the last few lonely months, it felt indescribably good. His silken cape brushed against her bare arms as he pulled her tightly against him. Slowly, she reached up to his face . . . and her real/virtual fingers found smooth, curved porcelain, warm from the heat of his face.

She gasped. *How* had Brent managed this?

Those piercing bicolored eyes locked on hers, and he bent to kiss her. His lips were gentle on hers when she suddenly discovered the only discrepancy in Brent's careful planning: the virtual Phantom had no facial hair, yet her actual upper lip felt an actual mustache. Which meant . . .

She pulled back, away from his grasp, and ripped the helmet from her head. Her limbs trembled and she was having trouble controlling her breath. Brent stood before her in complete Phantom regalia, down to a handmade white mask/VR helmet. The canvas bag of "laundry" lay open and empty.

He grinned impudently and winked the eye with the dark blue lens. "Like it?"

She struggled to find her voice. "It's very good."

"I wanted to impress you. I wanted to knock your socks off."

"Consider me barefoot, then." She would *not* let him know just how aroused she'd become during the VR scene. Keep matters technical. "How did you mesh your motions with the virtual image?"

Brent pointed to some small transmitters velcroed on his costume. "I move; he moves. Only trouble is, I'm limited to about a four-foot square area. If you moved across the room, the virtual Phantom could follow you, but I couldn't. Guess my face fuzz gave away the game?"

She nodded. It was easier than talking. She vividly remembered the first—and last—time Brent made a pass at her: ten years ago, after his marriage broke up. She was living with Neil back then, and though she liked Brent and was attracted to him, she'd rebuffed him out of loyalty to Neil. When she broke up with Neil a year later, Brent was living with April. Or maybe June.

She wrenched her mind back to the present, to whatever Brent was saying. "I barely had time to get into the clothes, let alone shave! But you think it was a success, except for that?" He sounded like a boy with a new toy.

"Yes. For a little while, I honestly thought I was in the lair with the fellow in the cape."

Another huge grin. "That was the idea."

"What about the game? You've completely messed up this round."

"Well, since I've been so wicked in showing off my creation, you decide what to do. Want to pick up where you were before the Phantom whisked you away or do you want to play defense, and I'll give you another crack at the Opéra House next round?"

She didn't hesitate. "I'll defend."

Trina's last Sondheim scene was New York, inspired by Boris Aronson's set for *Company*. It screamed 1970s: all glittery chrome and lucite, with the apartments

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on different levels, the curving staircases, and the double elevators. Rapunzel's lock of hair, the Sondheads' last object, was hidden in the bed of one of the upstairs apartments. She placed her defenders around the upper floor, with Guiteau and Booth guarding the staircases and Sweeney roaming at large.

"Where shall I go?" George asked softly.

"Stay by Guiteau, and stop anyone from going up the left staircase," Trina said, realizing that the only way George could even slow down the Phantom would be to smear paint on the stairs. "I'll stay with you."

The Webberites' assault began with a bang: one of those accursed *Starlight* trains made a kamikaze run into the apartment, starting a fire. In the confusion, the virtual valet made a run up the stairs past Booth, knocking the assassin to the lower level, where he lay stunned. But the brilliant manservant did not get past Sweeney. With a roar, the mad barber drew his razor across his throat and heaved the body over the side.

Out of the shadows, the Phantom appeared, bearing a heavy walking stick. "Bravely done, monsieur," he called, tipping his hat.

"Shoot him!" Trina shoved Guiteau, who seemed content to watch the others. *Damn, I should have given him more AI,* Trina thought. *Thought he had more initiative.*

The assassin fired and missed. In response, the Phantom raised the stick towards the left staircase. Two blazing fireballs hit the landing just above Trina, Guiteau, and George, cutting off their access to the upper floor. Smoke began to hamper Trina's vision, though there was no smell or sensation of choking. She vehemently wished that Lloyd Webber's musicals had fewer pyrotechnic effects.

"Care to try again, monsieur?" the Phantom taunted.

"You're mine, you bleeder," Sweeney growled. He dashed for the right staircase, razor held high.

It was hard for Trina to make out exactly what happened next through the smoky haze. The Phantom sidled past the valet's corpse and into the empty elevator shaft. The edge of his black cape was still visible. She craned her head around to check that the elevators were indeed still up on the top floor where they had left them.

"I have you now," Sweeney said, charging into the shaft after the Phantom.

A brief flicker of black on the opposite staircase caught Trina's eye. He couldn't have moved so quickly, could he? A sick feeling swept over her. "Sweeney, no! It's a trap!"

From his perch on top of the elevator bank, the now capeless Phantom screamed, "Go!" and the heavy car plummeted downward, crushing her beautifully murderous Sweeney.

"Fall back," Trina whispered to Guiteau and George. "Get Booth and fall back. There's nothing more we can do here."

Demoralized and disheartened, the Sondheads returned to the Paris Opéra House and barricaded themselves in one of the dressing rooms—*not* Christine's—to plan.

"How are we to stop this flame-throwing madman?" Guiteau demanded, plucking at his graying beard. "I saw him vanish into thin air with my own eyes, nothing left but the cloak."

"A formidable enemy," said George.

"And we've lost Sweeney," Booth said in his soft drawl. "Our champion."

Trina bit her lip in frustration. "We need to provide a distraction. I've got one in mind."

She paced the bridge over the lake, wondering if her gamble would pay off. If Brent truly intended to win, he'd keep his dazzling Phantom perched on top of the music box where none of her weak-

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er characters could dislodge him. On the other hand, he was very proud of his creation. Would he relish a second chance to show off?

"Trina . . ." The voice echoed through the mist. "You came back?" It was a question, not a statement.

"I had to." She wouldn't elaborate; let him make of it what he would.

The dark figure stepped out of the gloom. "Where are your gallant defenders?"

"Where do you think? They're searching for the music box."

The Phantom chuckled. "They won't find it. Someone very special is taking care of it."

"Who? The guy who's been hiding from all the action? I've crunched the numbers. Whoever he is, there's not much left in the AI for him." She pointed at the Phantom. "It's all in there."

He bowed deeply. "I appreciate the compliment. But believe me, my remaining teammate can take care of himself, even if he isn't long on brains. Come." They descended the bridge to the edge of the lake. The Phantom offered his virtual hand to her.

She took it and felt Brent's long cool fingers against hers once more, the fingers of a pianist. Her virtual form moved to step into the boat . . .

. . . as Booth and Guiteau rushed onto the bridge and pumped the Phantom full of nineteenth-century lead. He crumpled slowly, giving her hand one last squeeze. "Trina," he whispered, and ever afterwards she couldn't decide whose voice it was: Brent's or the Phantom's.

He fell at her feet, gazing up at her, the mask reflecting the soft light of the candles. She found she had to look away, that her throat was uncontrollably tightening. By contrast, her assassins were whooping it up on the bridge above her.

Then Brent's voice sounded in her ear. "Damn. That hurt to watch."

"He was . . . astonishing. Are you ready to surrender? You're outnumbered three to one."

"Hell, no! You haven't won yet."

Trina beckoned to her players. "Tear this place apart. Find that music box."

A long while later, after the Sondheads had gotten to know every last inch of Brent's design of the Opéra House, Trina reluctantly admitted the music box must be elsewhere. "The graveyard. It's the only scene not in the Opéra House."

A bare iron gate marked the entry to the graveyard, where cold, stark angels loomed over heavy, square monuments. Booth looked around with approval. "Plenty of good cover," he said quietly.

"I have a friend buried here," George remarked.

Guiteau glared at the artist. "If you don't keep your voice down, you'll join him."

But George had already given away their position. "About time you got here," virtual Brent called. "We were getting bored."

Trina's team slowly advanced in the direction of the voice. She peeked around a monument. Brent waved at her. He was sitting on top of a tombstone, holding a book. (*Permanent Parisians*, she later learned. Brent's sense of humor was wry.) The remaining Webberite, still cloaked head to foot, leaned against a block mausoleum nearby.

"Meet my final player," Brent said. The figure in the brown robe removed his hood, accompanied by six crashing chords.

He was bearded, with long flowing brown hair. His expression was benevolent; he raised one hand in blessing, while the other held the music box. Brent had even surrounded the man's head with a divinely tacky nimbus of light.

"Oh, Jesus," Trina said.

"Exactly!" Brent chortled. "How can I lose? God's on my side!"

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The virtual Jesus's image resembled that of the movie version of *Jesus Christ Superstar*. But Brent, never content with the ordinary, morphed the figure into a shifting array of representations by famous artists, starting with da Vinci's Last Supper Jesus and clicking through El Grecos and Raphaels and Michaelanglos. Trina's George watched in fascination; Guiteau seemed mesmerized, too. Only Booth remained wary, one long finger idly stroking his dark mustache.

The virtual Jesus settled on the original form once more and announced, "Thou shalt not kill. Thou shalt not steal."

Guiteau threw his gun aside with a clatter. "I am going to the Lordy!" he cried, running to Jesus's side. The virtual deity wrapped an arm around him, welcoming him.

Brent nearly fell off his tombstone laughing. "My odds are improving. Any more converts out there?"

Trina didn't want to wait to find out. She grabbed Booth and George by the arms and retreated, cursing herself. "That's what I get for being true to my characters! If I hadn't programmed Guiteau to be the former minister and deeply religious man that he really was, he'd still be with us. Booth, you have to shoot Jesus. You know it's not the actual Jesus, it just looks like him."

Lincoln's murderer hesitated. "I don't think I can. The others—the cats, the soldiers, the maniac in the mask—all fought back. This man, whether Jesus or not, represents our Savior and all he stands for. He is unarmed, an innocent among warlike beings. No wonder Charles felt drawn to his side. No, I do not think I can bring myself to fire upon him, even for the sake of our worthy cause. It would be sacrilegious."

Trina felt like screaming. Her team was up against the wall and John Wilkes Booth wanted a philosophical argument. "It's only an image, damn it!" she said.

"Which is more important, the image or the belief in the image?" he countered and walked toward the gate.

Almost in despair, she turned to George Seurat. His handsome face bore a quizzical expression. "These differing images of our Savior," he said, "are these visions? If so, why do we see them as other artists created them? How is this done?"

Terrific. Guiteau defects, Booth won't play, and now George wants a technical explanation. She was about to tell him never mind, the Sondheads were about to go down in flames, but he looked at her with those dark, intent eyes, and she decided to satisfy his curiosity, at least a little. It was her own fault, really. She'd created the best VR George Seurat she could—no wonder he was interested in art and images. His questions were a tribute to her use of AI. Considering the Sondheads' plight, Trina was glad to find *something* in which to take pride.

"They're not real," she explained. "That's what I tried telling Booth. Nothing here is real. The images of Jesus are made up of pixels."

"Pixels?"

"It's short for picture elements, George. Everything in *this* world, which is a virtual copy of the real world, is made up of pixels. The more pixels, the sharper and more definite the virtual image. Brent's Phantom, curse him, had millions of pixels. Joseph's brothers had far fewer; that's why they didn't look as good." *And,* she added to herself, *Brent wasn't as interested in them as he was in the Phantom.*

"I see." George brightened. "But this is akin to my theory of painting, pointillism. One may create pictures using nothing but dots of paint, which the eye of the observer blends to create a whole. Do these pixels come in many colors? I have long studied the spectrum, and how colors relate to one another."

"Yes. Each pixel can be a different col-

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or. In the early days of this technology, we were limited to just a few colors. Now we have millions, enough to satisfy even an artist like you." She smiled. There was something absurdly funny discussing artistic theory and computer graphics with George Seurat in a Parisian graveyard. "It *is* something like pointillism, George, though what you did with your dots was far beyond the skills of computer geeks like me, even if we have near microscopic dot pitch and high resolution output. We can't make masterpieces like your paintings."

George sighed. "How I should like to try this new medium!"

"I'm afraid that's not likely. Unless we can find a way to get that music box, this game will end, and we'll lose. If only I could get Booth to commit deicide." She broke off abruptly as the import of George's words sank in. "Hurry. Back to the Opéra House. There's one last thing we can try."

They found Booth slumped against the gate, brooding. "Are you still with us?" she asked him.

"As ever. I am not a traitor, although I cannot do that which you asked me to do." Ham actor that he was, he struck a pose.

"Fine. I've got a plan. You wait here."

Back at the Opéra House, she produced a five-dollar bill and showed it to George. "This is a picture of Abraham Lincoln, the American president who was assassinated by John Wilkes Booth in 1865."

"I was a boy then," said George.

"Yes. I need you to create this man's picture, wearing a black stovepipe hat, using pixels the way you would use dots of paint." She accessed the graphics program for the George image himself with her palm control. "This is how you're made, George: pixels of color and light. If I could hack into Brent's program for Jesus, I'd have you completely morph him into Lincoln, but I can't. The best we can do is adapt part of your own program to make a flat, ghost Lincoln. We don't even have time to create a wireframe skeleton for him, and, besides, that would take too much away from your own form. Here's how you do it."

George caught on quickly and Trina left him with the virtual palm control, which was, of course, keyed to the actual one. As he worked, Trina wandered the stage, carefully avoiding the gendarme's fallen body. She'd gloated when the young policeman fell, but Brent was right about the Phantom's death: seeing the destruction of something so magnificently wrought was painful. She was tempted to return to the shore of the lake to learn exactly how much AI Brent had invested in the program. It had to be a staggering amount. But she didn't have time. The game's rules prohibited spending more than an hour inactive, and the Sondheads were edging close to that limit. She returned to George.

"We have to go," she told him.

"But I haven't finished the hat!" he protested. Having stolen from his own program to create the Lincoln, George was looking fuzzy around the edges himself, not merely his false beard. The beautiful dark eyes had become murky.

"Never mind. It's now or we forfeit."

The virtual Lincoln was damn good for a hasty job, though resolutely two-dimensional and completely lacking in AI. Trina carried him under her arm as they made their way back to the graveyard. She could barely make out Booth in the distance, still sitting by the gate. Not wanting him to see Lincoln, she left the president with George and advanced alone.

"Booth," she said, "I've discovered Brent has another character, one he's kept hidden because he knows he could never keep that player safe from the likes of you. Are you game to go after him?"

"A coward, eh?"

"That's your opinion of him, yes. Make your way to the mausoleum where we left them and keep hidden until my signal."

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He nodded fiercely. "As you wish."

As soon as he had gone, she fetched George and Lincoln and approached Brent's position from the other side. "Run in there and stand Lincoln up in front of Jesus," she instructed George. "We'll have to hope he fools Booth long enough."

George did as he was told, propping up the flat Lincoln as deftly as the modern George manipulated his cardboard cutouts in Act II of *Sunday*. Brent stared, not understanding what was happening, as Trina yelled, "Now, Booth!"

The assassin took one look, screeched, "*Sic semper tyrannis*," exactly as Trina had programmed him, and fired. The bullet went through the flat president and hit Jesus, who crumpled. The music box fell from his hands. Guiteau uttered a wordless cry of anguish and threw himself across Jesus' body.

George, his form wavering slightly around the edges, picked up the music box. He triumphantly raised it over his head. "The Sondheads win."

"I admire your ingenuity, but if you want to get technical," Brent said over dinner that night at Art's Deli on Ventura Boulevard, "you cheated."

"No, I didn't," Trina countered. "Our rules said the characters had the abilities that they had in the stage productions and could use whatever was at their disposal in each locale. George was an artist. So he painted a Lincoln and Booth blew him away. They both stayed in character."

"He used *your* palm control!"

Trina grinned. "Well, maybe that was a teensy bit unethical, though it was 'in the locale.' But what about your Phantom? The rules also say that your virtual character is supposed to be distinct from your players. I couldn't tell where the Phantom left off and Brent Birley began."

His hazel eyes lit up. "You couldn't? Then I concede the game to your Sondheads without further discussion. As long as you approve of my Phantom, that's victory enough for me. I *slaved* over that program."

"It showed. He was breathtaking." She didn't want to admit how breathtaking. What on earth did that say about her emotional state?

Fortunately, Brent turned the conversation around to some of the more absurd rounds, allowing Trina to exult in her team's victory.

A month passed in which Trina reveled in control of the office's CDs. Naturally, she didn't play only Sondheim, nor did she ignore Brent's favorites. After all, he was being a good loser. He gave her a custom-made trophy: a music box that played "Send in the Clowns" glued on top of a faux marble block with a plaque reading: CHAMPIONS OF THE GREAT WHITE WAY WAR GAME—THE SONDHEADS. Trina treasured it.

One morning, she arrived and found a note stuck to her monitor saying Brent would be late. When he finally burst through the door at half-past ten, he was triumphantly singing "You Did It" from *My Fair Lady*.

"What have you done now?" Trina asked. It was good to see Brent in a gonzo mood again; he'd been unusually quiet of late.

"I showed the Phantom program to Dobashi two weeks ago, and he went bonkers. He's shown it to marketing. They've generated some insane numbers, which they're taking to Sir Andrew's Really Useful Company."

"You're joking, right?"

"No, Dobashi thinks there could be a huge demand for an interactive Phantom. Think of it, ladies! You too can be Christine! If this flies—which it may not, considering they may well want to keep the property a purely theatrical one—it would mean an incredible amount of money."

He paused. "I showed Dobashi your Sondhead programs, too. Unfortunately, our talented boss has no cultural taste.

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He'd never even heard of Sondheim."

Trina snorted. "What, you mean there's no market for VR assassins and cutthroat barbers? I'm shocked, shocked."

"It's a damn shame," Brent said. "They're terrific programs—and so devious! You must have worked out hundreds of test cases."

"I had time," Trina said dryly.

Brent shook his head in disbelief. "I still can't get over the numbers the sales guys were citing. I mean, I'm a simple computer geek—what do I know about what the public wants?"

"For God's sake, Brent, it's simple," Trina snapped. "It's the very heart of our original argument: John Q. Public prefers Sir Andrew's comfortable musicals to Sondheim's edgier ones. Naturally, the same holds true for any VR adaptations. Don't be so dim." She lovingly ran her hand over her trophy. "But, like Sondheim, although I may not reap the commercial benefits of our contest, I've got the award. It's not a Pulitzer, but, damn it, I worked hard for it."

Brent gave her a strange look. He frowned and turned to the stereo system, which was playing Rodgers and Hart's *The Boys From Syracuse*. "I'm going about this all wrong. Can I change that CD and make an announcement?"

She waved her hand. "Makes no never mind to me. Though I am happy for you, Brent. I hope everything works out for your program."

Brent was on his knees, rooting around the shelves. Much to Trina's surprise, he pulled out Sondheim's *Merrily We Roll Along* and keyed in a specific track: "Old Friends."

"The most appropriate song I could think of," he said. "I'm doing this badly, but what I'm trying to tell you, old friend, is that I've registered the VR programs in *both* our names."

"Are you nuts? He's your Phantom! I didn't have a thing to do with him!"

"You inspired me to design him, Trina. Besides"—he tilted his head quizzically—"how else can I repay you for what you did last year?"

"I don't know what you're talking about."

"After that especially nasty meeting you two had at the lawyer's in May, Bill told me about your standoff with Dobashi. I think he wanted to hit at somebody. Since he couldn't make you feel any worse, he went after me. So how else can I purge my guilt, except by giving credit where it's due?"

"The bastard! He had no right to tell you."

Brent shrugged. "I'm glad he did. I was going to list you as co-creator anyway; now you have no choice but to accept. Fair's fair, partner." He stuck out his hand.

She took it and they exchanged a hearty squeeze as "Old Friends" played out. They both returned to their desks, but Trina soon realized Brent's mind was not on his work. He kept fidgeting: playing with paper clips, scrolling up and down some text, but clearly not reading it. Finally, he wheeled his chair backwards and asked, "Did you *really* like the Phantom program? Honestly?"

"I already said so. It was unbelievable."

"Want to go back there?" He practically spat out the words. "You see, I had two more verses written for you. *Not* ones I showed Dobashi. He only heard the original lyrics."

She studied him: a dear, weedy man with silver threads beginning to streak his hair and dark circles under his eyes, the one constant figure throughout her adult life. "Does this have anything to do with the fact that for the first time in all the years we've known each other, we're both single?"

"Well, sort of." He hurled a mangled paper clip into his trash can with unnecessary force. "Damn it, why do you think I used the Crawford Phantom and not the Wilkinson? I was *trying* to seduce you! And the hell of it is, I was planning this even before Bill left you,

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which tells you what kind of a guy I am." He swallowed hard.

She shook her head. "No, I don't think I want to return to the Phantom's lair."

Brent's face fell and his hands clenched in such a way that if he still was holding a paper clip, it wouldn't have been long for the world. She continued: "The lair of his programmer is another matter. The virtual Phantom was all very well—very well indeed!—but you have to realize it was your actual physical touch that meant much, much more."

"But your reaction when you realized it was really me?"

"I was stunned. And I don't think I was quite ready to admit to myself exactly what that meant." She walked across the room to embrace him. "I'm ready now."

Sometime much later, they were both thankful that Y.A.T. had given them that private, soundproofed studio, though Mr. Dobashi would have undoubtedly disapproved of the way they had used the furniture.

Relaxing in Brent's arms, Trina remarked, "I'm reminded of another Sondheim song, one from *Into the Woods*."

"'Agony?'" asked Brent.

"No," she said, "'It Takes Two.'" ■

IN TIMES TO COME

Last October, in "Stealing the Sun," Ron Collins left the inhabitants of a distant planet with a world-class predicament. They didn't know it, but some inconsiderate aliens (humans), were "telesiphoning" energy from the interior of their planet's sun—which is, to put it mildly, not good for their long term survival. Next month, in this year's lead novelette for October, we see things from their point of view as they begin to get an inkling of what has been done to them—and what they can do about it. It's a formidable problem, and "The Taranth Stone" inspired a striking cover by Kelly Freas.

We'll also have a couple of "seasonal" stories, in quite different ways, by Kathy Oltion and James Van Pelt; a highly unusual and memorable novelette by relative newcomer Rajnar Vajra; and more fiction by Charles L. Harness, Sean McMullen, F. Gwynplaine MacIntyre, and Catherine Wells.

Ashley J.R. Carter's science fact article looks at the "Limits to Evolution." It's sometimes assumed that "nature always finds a way," but in fact it doesn't; what evolution can accomplish depends not only on the laws of physics and chemistry, but on what it has already done and can therefore build upon. (Which, interestingly, implies that one world's evolution may be able to do things that another's can't . . . .)

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THE REFERENCE LIBRARY Tom Easton

The Quiet Invasion, Sarah Zettel, Warner, $23.95, 419 pp. (ISBN: 0-446-52489-1).
Venus, Ben Bova, TOR, $24.95, 382 pp. (ISBN:0-312-87216-X).
The Light of Other Days, Arthur C. Clarke and Stephen Baxter, TOR, $24.95, 316 pp. (ISBN: 0-312-87199-6).
The Depths of Time, Roger MacBride Allen, Bantam, $13.95, 426 pp. (ISBN: 0-553-37811-2).
Avalanche Soldier, Susan R. Matthews, Avon, $6.50, 251 pp. (ISBN: 0-380-80315-1).
White Mars, Brian W. Aldiss "in collaboration with" Roger Penrose, St. Martin's, $22.95, 323 pp. (ISBN: 0-312-25473-3).
Terminal Visions, Richard Paul Russo, Golden Gryphon Press (3002 Perkins Road, Urbana, IL 61802), $23.95, 275 pp. (ISBN: 0-9655901-3-5)
Haiku by Unoho, Keith Daniels, Anamnesis Press (P. O. Box 51115, Palo Alto, CA 94303), $9.95, 68 pp. (ISBN: 1-892842-09-2).
Farmer Giles of Ham, J. R. R. Tolkien, Christina Scull and Wayne G.

Sarah Zettel just gets better and better. She earned high praise for her first three novels (*Reclamation* [reviewed in my June 1996 column], *Fool's War* [May 1997], and *Playing God* [November 1998]). Now she offers us **The Quiet Invasion,** and I defy you not to enjoy it.

The premise is fairly traditional. Earth has been unified under the UN, and the US's disarmament was a bloody affair. There are colonies on the Moon and Mars, and when the Martians rebelled, the blood flowed again. The UN rules with a firm hand, and the colonies are not permitted anything resembling freedom or autonomy.

There is also a colony at Venus, the research city of Venera, floating high in the noxious clouds and facing crisis as the funds that keep it alive dry up. One of its people, Grace Meyer, is a second-rate chemist who is sure she has spotted primitive life-forms in the atmosphere. Others, exploring on the surface, find a mysterious construction, a borehole leading to several rooms deep beneath the surface.

Wow! Aliens! Suddenly the funds flow free and a squad of UN-picked investigators is on the way to take the Discovery out of local incompetent hands and study it properly. Resentment flowers despite all the excitement, and when one of those investigators gets suspicious. . . .

Meanwhile, on a world far, far away, the People face an ecological crisis. They are fliers who feed by absorbing food from the air, through pores. They grow flying cities and dirigibles and assorted equipment, have great respect for life, live in beauty and honor, and are mightily distressed that the food supply is declining and both cities and the canopy (the forest on the ground) are being stricken down by rots and cancers. They need a new home, and they have been investigating several. Unfortunately, on only one did their test plantings succeed, and it has the New People to consider.

No points for guessing who the New People are or what Grace Meyer really

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found. More to the point, meet Ambassador T'sha, who wishes to evaluate the New People's claim to New Home; if they have one, then the People cannot move in. Meet Ambassador D'seun, who believes the People's need has primacy, and if the New People get in the way. . . .

Politics, politics, all is politics. Back at Venera the separatists are stirring. Scandal has erupted over the Discovery. Murder is brewing. And two exploring crews get into trouble. When Ambassador T'sha comes to the rescue. . . .

Wow again! Real aliens, this time! Live and talking and saying, "Nice place here. Looks empty. Mind if we move in? And sure, we'll give you a hand if the folks over yonder on Earth want to play rough."

Some people are thrilled. The separatists are delirious. Some are scared spitless. And the UN is sending troops now.

What's the upshot? Zettel has the gift of knowing when to stop pushing the melodrama. If she is too optimistic, it is surely in underestimating the vindictiveness of the UN at the end. Still, one ends the book with a sense of resolution and a richly interesting future for humanity.

You'll love it.

Ben Bova's **Venus** is a tale of a runty little twit who finally grows up. Van Humphries is small and sickly—suffering from a form of anemia derived from his mother's drug addiction; she died when he was born. He uses the stipend from his SOB father—who has told him all his life he killed his mother and should be dead himself—to support the lifestyle of a self-indulgent, self-pitying, eternal dilettante. His older brother, Alex, was brilliant, active, and beloved of both Dad and Runt. Alex is also dead, victim of an attempt to explore Venus.

So now Daddy Dear has just announced an 18-billion-dollar prize for whoever brings back Alex's remains. Since this is a bit much even for him, he has to economize. So there goes Van's stipend.

But Van's not a total wimp after all. He talks to friends and banks and gathers enough financial backing to build a ship. He will go to Venus himself, bring back whatever's left of Alex, and collect the prize himself. A typical dilettante, he starts off larding the crew with his buddies, but that soon ends. Meanwhile, out in the Belt, Lars Fuchs, sworn enemy to Daddy Dear, is mounting his own expedition, shrouded in secrecy.

And they're off. Van's captain is a woman who dragged her daughter Marguerite aboard as biologist. Van rather likes Marguerite, though she isn't much impressed by his attitude toward work. And when she finds life in the clouds of Venus. . . .

That's when things go drastically wrong. Soon Van and Marguerite are the only ones left of the expedition, and they live only because Lars Fuchs rescued them. Now Van has to learn a great deal, beginning with a bit about work and progressing through a number of truths about Daddy Dear, his mother, and himself. Not surprisingly, he winds up a better human being and gets the girl as his reward.

Bova's style is plain and straightforward and serves his theme well. However, I found his major characters distinctly unappealing, while the minor ones are caricatures. If you prefer more likable and rounded characters in your fiction, you may prefer to give this one a miss.

Arthur C. Clarke has suffered a number of disappointing partnerships lately. But now he's teamed with Stephen Baxter, and **The Light of Other Days** is a ripping great yarn.

The Internet has come a long ways. Thanks to retinal and other implants, ubiquitous cameras, and a wealth of processing power, all you need do is ask for information, and it is there—even if all you want is a virtual mirror in which to check your hairdo. But Hiram Patterson, a deeply flawed personality who has

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built a fortune on infotech, is about to ratchet things up a bit. His OurWorld scientists have learned how to make miniature Casimir Engines, which exploit quantum forces to create wormholes through which information can be piped. No more lightspeed lags, no more comsats, no more fiber optics.

Meet Kate Manzoni, a journalist who made her rep by uncovering the government conspiracy to keep Wormwood—a comet hundreds of miles across, on track to hit Earth in 500 years, and damn-all anyone can do about it!—a secret from the public. There's a lot of fatalism in the air, and now she's visiting OurWorld to cover the wormhole rollout. She's also meeting Hiram's son Bobby, who's nice enough even if he doesn't seem all there, and gaining an invitation to come visit later on.

So she's there when OurWorld makes the wormholes steerable—and anyone can look over anyone's shoulder. Privacy is done.

And again when they gain the power to look back in time! No more can the corrupt and criminal hide the evidence of their misdeeds. In fact, no more can anyone hope to hide even minor peccadillos and embarassments. And all the myths of history can be corrected.

There's a growth industry there, and more than enough change to turn a world upside down. That's part of the tale, and a part that furnishes all the sweep and scope we might expect of Clarke. But there is also the interpersonal drama of Kate's encounter with the Patterson family, her uncovering of truths, the enmity she rouses in Hiram, love and condemnation, flight and salvation, and a great deal more. This gives the novel a focus and drive that serve it very well.

With **The Depths of Time**, Roger MacBride Allen begins what looks to be a very satisfying series.

The time is thousands of years hence. Interstellar travel is slower-than-light, but the crews—preserved by cryosleep, with a more expensive time-stasis trick for the captains—nevertheless manage to return to their own times. The trick is the combination of stl travel with wormhole time travel: Take a century to crawl out to the wormhole, jump two hundred years back, crawl another century forward, and arrive at the same time you left. Neat trick, but the Chronologic Patrol worries about information moving from future to past and upsetting causality. It therefore takes great care to prevent information movement, to the extent that its ships posted at the futureward ends of wormholes are allowed no contact with the ships they usher pastward, and if they slip, they are marooned in the future.

There are some problems with this scheme, for "no contact" is impossible. Still, it's a gimmick that drives the tale, and when the Chronologic Patrol Ship *Upholder* spots a flock of robotic "Intruder" ships diving into the pastward end of the wormhole whose futureward end it guards, it does its best to shoot them all down. When it fails, it blows the wormhole, even though a convoy of ships laden with equipment for Glister, a colony whose terraforming is collapsing, is approaching the hole's maw.

Captain Anton Koffield is thoroughly exonerated when his ship limps into base eighty years later, but now he is known as the man who killed a world, Glister. He did just what he was supposed to do, he protected causality for Earth and all its terraformed colonies, but he is seen as Death Incarnate.

Tough breaks, Tony. Take your promotion to rear admiral and stay out of sight, hmm? At least until Dr. Oskar DeSilvo recruits you to help write the history of his masterpiece, the terraforming of Solace. And now let's have a little ellipsis, until the good ship *Dom Pedro IV* approaches the Solace system. Its captain awakens, finds to his horror that the ship's clocks are zeroed but external

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checks show that 127 years have passed since it was supposed to arrive! It never took its wormhole shortcut, and its passenger, Anton Koffield himself, is over a century late with his warning of ecological collapse.

Fortunately, folks at Solace are willing to listen to Koffield, for the collapse is right on schedule and Koffield's math, which predicts more and worse, checks out quite appallingly. Worse yet, all responsibility tracks straight back to the master, who even though he is widely supposed to be dead seems to have a thoroughly secret agenda whose further exposure will drive the next book or two.

Any biologist is sure to find Allen's speculations about the ecological stability of terraformed worlds thoroughly enchanting. It has long been a dogma in the field that stability and complexity go together, and it seems obvious that a terraformed world could not possibly be as complex as a world that has had all Earth's eons to multiply species and symbioses. The most ambitious artificial ecosystems we have built so far (the Biosphere II greenhouse) ran into serious trouble rather along the lines Allen discusses. Yet this dogma has been questioned in recent years. We can also point to counterexamples in "balanced" terraria and aquaria, which though simple can be quite stable.

Such thoughts make me more sanguine than Allen about the long-term prospects for terraformed worlds. But don't let that stop you from enjoying the tale. Koffield is a tragic hero to rank with the best, and it doesn't hurt a bit that he has a little something developing with his pilot, Norla.

Susan R. Matthews displayed both great daring and great promise with her first novel, *An Exchange of Hostages* (reviewed here October 1997) and its sequels. Her latest novel, **Avalanche Soldier**, disappoints only because it seems more ordinary.

The setting is the world of Creation, dominated by a religious orthodoxy derived from revelations experienced by the ancient folk of the mountains. The gist is that the world is a dream, and someday The Awakener will come to open people's eyes. Centuries past, the mountain folk left the mountains for the plains, built a technological civilization, and established space colonies. Then a plague struck. The colonists fled home, reeling under what could only be the stern admonishment of their god to abandon space, science, and technology and return to their roots. Unfortunately, by then the home mountains had been settled by new folk, the Wayfarers, who interpreted the scriptures a bit differently (yes, the world is a dream, but there have been, are, and will be many Awakeners, each one opening people's eyes a crack).

Here then is the stuff of a familiar sort of conflict. Now meet Salli Rangarold, avalanche soldier dedicated to protecting the mountain shrines and their visitors against the dangers of both avalanche and terrorist. Her brother Meeka is a city cop who, having killed a rioter, has left his post and vanished. When Salli goes to investigate, she finds he has also abandoned Orthodoxy. He is with the Wayfarer heretics, converted by their latest Awakener.

And when she gets close enough, Salli too sees the Light! Karrick, who preaches that it was rather stupid and presumptuous to abandon the stars (Hey, a plague is just a plague!), is not just *an* Awakener, but *the* Awakener. And the authorities obstinately refuse to see the truth.

What to do? You can draw a likely list of answers from Earthly history, just as Matthews did. Perhaps you can guess that the one that matters is the one inside, the one you take with you to life, love, and community.

Enjoy.

If the unreadably pretentious **White**

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Mars Or, The Mind Set Free: A 21st-Century Utopia were by unknown authors, it would be easy to dismiss it without a review. But the authors are SF luminary Brian W. Aldiss and distinguished physicist and philosopher Roger Penrose. That warrants some attention; unfortunately, its authorship is the most interesting thing about the book.

Penrose is known for his work on black holes with Stephen Hawking, for coming up with "Penrose tiles" (see http://www.ics.uci.edu/eppstein/junkyard/penrose.html), and for the book *The Emperor's New Mind*, in which he proposed that the foundations of mind lie in the quantum realm and took extreme issue with the premises of artificial intelligence and mind downloads. Aldiss needs little introduction, though in this context we should note that he is the president of APIUM: Association for the Protection and Integrity of an Unspoilt Mars, which pretends that a place without life can be an environment (a term dictionaries define as the surroundings of living things) that deserves protection from human depredations and proposes that Mars be treated much like Earth's Antarctica, a "White Mars" devoted to science, silence, meditation, and honeymooning, with visits funded by community service on Earth so that "a myth of peace will spread back to Earth, supplanting the myth of energy/power/exploitation that has so darkened the twentieth century."

And thus it begins, with the United Nationalities (many conventional terms are strangely altered—"space" even becomes "matrix") setting up a program along the lines of the APIUM agenda. A Mars base is built and populated and visited. When the consortium that operates the program is discovered to be riddled with graft, collapses, and brings Earth's economy down with it, the base is isolated. Led by idealist Tom Jeffries, its six thousand people discuss how to go about creating a utopia and set out bravely on the task. They encounter minor problems, but they deal with them. Major problems, such as human nature, fall like houses of cards before the hot wind swirling around mountainous expository lumps, lengthy discussions of the problems of human civilization, their roots in parenting and politics and economics, and the solutions so obvious to the utopian mind. Penrose's tiles and quantum minds are here, too.

Sadly, the greatest wonders of Mars are virtually ignored. The landscape is barely more than that (and a canvas for graffiti). The vast alien creature soon known as Chimborazo is marveled at but not analyzed—gut-based intuition provides all description of its nature and origin, and in this perhaps lies what to my mind is the greatest problem of the book: a basic disrespect for rationality and the processes of science.

Aldiss's work—interesting as it has been—has always suffered for being more humanistic than based in hard reality. Penrose is certainly a scientist, but his work on the nature of mind is essentially fantasy; he insists that mind is mysterious despite the claims of such as Ray Kurzweil and Hans Moravec about its basic comprehensibility in terms of computer software; it is unknowable and unpredictable, and therefore it must be quantum in nature. Here both display a distrust of science and technology and an ignorance of the historical truth that technological progress has improved the lot of humanity in general, even in the social sense of freedom and autonomy.

I expect better, even in utopian novels. *White Mars* is a dreary work, without charm or appeal or credibility.

If you enjoyed Richard Paul Russo's novels (I reviewed *Subterranean Gallery* here in April 1990; *Carlucci's Edge* in January 1996; *Carlucci's Heart* in April 1998), you will be delighted to hear that he now has a collection of fourteen equally enjoyable short stories available. The stories in Terminal Vi-

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sions are skillful and quirky and truly quite marvelous, from the transdimensional carjacker to the madly flying window washer, and if the mood often smells of despair, it is redeemed by a final eager, what-the-hell grasp for the brass ring.

As Karen Joy Fowler says in her laudatory introduction, Russo's short fiction is a secret that is meant to be shared.

Spend the money. You'll be glad you did.

Keith Daniels says the title of his latest, **Haiku by Unoho,** is a bit of a lie, for true *haiku* must mention seasons. Verses of identical form that fail in that regard are *senryu*. (And if they deal with SF, they have been dubbed *scifaiku*.)

But Daniels's only failure lies in the absence of seasons. In all else, this little book is a gem. Daniels has the touch, as he shows in "Progress: Alchemy is dead / today. Philosopher's stones / are found in kidneys." The cover art (by his wife Toni Luna) is aptly described by "Animé Babe: She rides a three-eyed / purple snail, her pokey steed / since Pegasus died."

NOTABLE REISSUE

Houghton Mifflin has just brought out the fiftieth anniversary edition of J. R. R. Tolkien's **Farmer Giles of Ham.** Those who remember fondly those halcyon days when Tolkien's *The Hobbit* and *Lord of the Rings* took the West by storm and essentially created modern fantasy will be happy to see this little hardbound, complete with a few scholarly notes, the brief first draft (written out after the tale was first told aloud for the Tolkien children in the mid-1920s, while waiting out a rainstorm under a bridge), and Tolkien's notes for a never-written sequel.

For those who do not remember—*Farmer Giles* is an intelligent and witty fairy tale that reads as well today as it did when first published in 1949. It concerns a country farmer who more or less by accident scares off a giant and is rewarded by the king with an ancient sword. When a dragon later shows up in the neighborhood, the sword turns out to be a famous dragon-bane, and the farmer winds up a man of wealth and stature. The deftly done illustrations are a delight in their own right, and the flavor if not the content is much the same as in *The Hobbit*. ■

Most humans have an almost infinite capacity for taking things for granted.

— Aldous Huxley

We should quietly hear both sides.

— Johann Wolfgang von Goethe

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BRASS TACKS

Dear Editor Schmidt,

Thank you for continuing my favorite magazine. I've enjoyed many years of pleasantly reading *Analog* stories, but the first thing I read is your editorial, Brass Tacks and the science fact article (old engineer you know!). *Analog* and I are the same age—and I picked up my first copy at age 8. This is my first letter to you, and it is regarding your editorial "Initial Conditions" and the letters in your March issue, especially that of Howard Mark. Mr. Mark overlooked many of the factors that affect this issue. His comments might apply if you could trace the generations directly and the "theft" were clearly defined. Since I live in Onondaga county, I'm well aware of the land claims being made by the American Indian Nations. Particularly in the state of New York. Here, many of the current landowners own property legally purchased under the laws of the land. My parents came from Europe in the early 1900's and bought land from people that had a legal title. Now two centuries later someone thinks they have a claim to this property! No way is there any legal history that can substantiate this type of claim against an individual. Maybe a political negotiation between legal national entities but not individuals.

Bob Kanik
North Syracuse, NY

Dear Dr. Schmidt,

This is a bit of a nit pick, but as a thermodynamacist, though retired, I cannot let Ben Bova's error go by. In his "Death on Venus" (an excellent read, I look forward to the book), he says, "Venus's [upper atmosphere] is almost four hundred degrees Celsius, four times hotter than water's boiling point." That simply is not true. To express a ratio of temperatures, one can not express the temperature in degrees Celsius. One has to use the Kelvin scale of absolute temperatures. In degrees Kelvin, water boils at 373 degrees. Four hundred degrees Celsius is 673 degrees Kelvin or 1.8 times as hot as water's boiling point. Ben Bova's science is usually so excellent that I am surprized that he missed this point.

Don Hirsch
dehirsch@excite.com
Lakeland, FL

Dear Dr. Schmidt,

That Jeffrey Kooistra character has gone and done it again, dammit! In his article "Aether One or the Other", he skewers yet another supposedly solid fact from my college physics courses, namely the result of the Michelson-Morley experiment. What's a fella to believe anymore? It's bad enough that he shows how the experiment could have had a null result even if an aether does exist. Worse yet, he says, "It's been shown many times that the Michelson-Morley experiment was inherently null in design." Now wait just one minute. Who has shown this, and if it's been done so many times, how come I don't know about it? OK, I'm not a physicist (although I briefly entertained notions of majoring in it 25 years ago), but I like to think that I keep up on the latest devel-

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opments to some degree. How about a reference, Mr. Kooistra? In fact, how about *lots* of references, for all of your columns? I really would like to think you're not making this stuff up! I'm being somewhat facetious, of course. A number of references were included in this article (sigh, more reading I don't have time for). However, it always seems to be the most outrageous or annoying statements (and I mean that in a good sense) that are left unsupported, like that offhand remark near the end regarding Feynman's statement that electrodynamics isn't self-consistent. Keep up the good work, Jeffrey. It's usually a toss-up as to what part of Analog I read first, your column or Stan's editorial.

Tom Fielder
tjf@zotnet.net

Dear Dr. Schmidt,

Many of the issues you've pointed out are of great concern and the yearly *Forbes* ASAP[1] issue addresses similar problems with the "global convergence" we are going through. Particularly the homogenization of telecommuting employees, as our service economy becomes more an information economy, points towards an ultimate automation of the employeeless business. Recall, this process was stalled in the days of expert systems when many were less than thrilled with the idea that their expertese could be coded, making them expendible by software clones of their wetware. Then along comes the Santa Fe Institute, et al, with models of "order out of chaos"[2], and Xerox PARC &c., with the idea of language-independant software[4]; the logical extension of which is towards that idea of "personality independance" which is needed to make the usual business hierarchies unnecessary. The machine language of the industrial age, where tangibles were the commodity was dominanted by the blue-collar workers. The service economy, was dominated by a higher-level language of white-collar workers. Now, in this information age, the commodity has become extremely virtual, and the typical employee will have less required of them in terms of physical actions and presence. Only their subjective presence will be required in the interpretation and funnelling of the vast amounts of raw data. American society seems to be becoming a model of a computer "push-button interface", where the underlying "software" is outsourced to service economies like India and the tangible machine operations are outsourced to industrial economies like Asia. There are many other bellwethers indicating how the future implies "real-time" living[3]. It has always been the case that controlling people meant controlling their time. In this world one either punches a clock, keeps a schedule, or makes other people's schedules. How much control one has over ones own time correlates strongly with whether they get paid a wage, a salary or a fee respectively.

[1]Forbes ASAP
http://www.forbes.com/ASAP/
[2]"Armies of brainless robots will make the perfect labourers"
http://www.newscientist.com/news/news.jsp?id=ns2223111
[3]The Second Society
http://www.crosstouch.com/crosspoints/sld004.htm
[4]Language Independance
ftp://ftp.parc.xerox.com/pub/ilu/ilu.html
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http://www.bestweb.net/~ca314159/

Robert Fung
Peekskill, NY

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UPCOMING EVENTS Anthony Lewis

25–27 August 2000

BUBONICON 32 (Albuquerque-area SF conference) at Albuquerque, N.M. Guest of Honor: Walter Jon Williams; Artist Guest of Honor: Lela Dowling. Registration: $20 until 14 February 2000, probably more later. payable to NMSF Conference. Info: NMSF Conference, Box 37257, Albuquerque NM 87176; phone: +1.505.266.8905; e-mail cwcraig@nmia.com

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31 August–4 September 2000

CHICON 2000 (58th World Science Fiction Convention) at Hyatt Regency, Chicago, Ill. Guests of Honor—Ben Bova (former editor of Analog), Bob Eggleton, Jim Baen, Bob & Ann Passovoy, TM—Harry Turtledove. Registration—$150; supporting $40. [These rates are good until 30 April 2000; they may go up again. These are the latest rates posted on the Internet as of the time this column went to press.] This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Info: Chicon 2000, Box 642057, Chicago, IL 60664. email: info@chicon.org URL:www.chicon.org/

8–10 September 2000

COPPERCON 2000 (Arizona SF conference) at Holiday Inn Sunspree Resort, Scottsdale Ariz.; Guest of Honor—Philip José Farmer. Registration: $30 until 26 August 2000, $35 at the door. Info: CopperCon 2000, P O Box 62613, Phoenix AZ 85082-2613; +1.602.973.2341; e-mail: cucon@casfs.org; URL: www.casfs.org/cucon

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29 September–1 October 2000

ARCHON 24 (downstate Illinois SF conference) at Holiday Inn & Gateway Ctr., Collinsville Ill. Guest of Honor - Larry Niven; Artist Guest of Honor - Larry Elmore; Fan Guests of Honor - Genie Yaffe, Amy & Dave Verseman. Registration: $30 until 31 August 2000, $35 at the door. Info: Archon 24, P O Box 8387, St. Louis MO 63132; +1.314.326.3026; e-mail: archon_info@ zellich.net; URL: www.stlf.org/archon/24

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29 September–1 October 2000

TRINOC-CON 2000 (North Carolina SF conference) at Marriott & Civic Center, Durham N. C.; Registration: $30 until 31 August 2000, $35 at door. Info: Trinoc-con, P O Box 10633, Raleigh NC 27605; e-mail: lauragale@mindspring.com; URL: www.trinoc-con.org

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26–29 October 2000

WORLD FANTASY CONVENTION 26 at Omni Bayfront, Corpus Christi, Tex. Guests of Honor—K. W. Jeter, John Crowley; TM—Joe Lansdale. Registration - $90 until 10 November 1999, then more. Info: WFC 2000, Box 27277, Austin, TX 78755. +1.512.835.9304 (voice), +1.512.835.7637 (fax), email: fduartejr@aol.com URL: 2000.worldfantasy.org

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